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Using Knowledge Value Added (KVA) for evaluating cryptologic it capabilities trial implementation

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THESIS

USING KNOWLEDGE VALUE ADDED (KVA) FOR EVALUATING CRYPTOLOGIC IT CAPABILITIES: TRIAL IMPLEMENTATION

by

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September 2007

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13. ABSTRACT (maximum 200 words)

Program managers throughout the DoD are faced with technology portfolio management problems. Critical to these efforts is the need to track the performance of the technology on a routine, ongoing basis. This thesis focuses on solving this general problem in the specific context of the United States Navy's Cryptologic Carry-On Program (CCOP). This study provides a demonstration of how a software suite that monitors process performance can be implemented to provide ongoing return on investment information about CCOP technology. This follow-on research and trial implementation demonstrate how the Knowledge Value Added (KVA) Methodology that is embedded in the performance monitoring software is used to formulate a framework for extracting and analyzing performance parameters and measures of effectiveness for each CCOP system. KVA was used to measure the effectiveness and efficiency of CCOP systems and the impact they have on the Intelligence Collection Process (ICP) onboard the USS GONZALES. The analysis of the subprocess outputs involved in the ICP in common units of change, a price per unit of output is generated to allocate both cost and revenue at the subprocess level. With this level of financial detail, a return on investment (ROI) analysis can be conducted for each process.

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ABSTRACT

Program managers throughout the DoD are faced with technology portfolio management problems. Critical to these efforts is the need to track the performance of the technology on a routine, ongoing basis. Current basic accounting systems are of very limited usefulness because they do not provide a means for tracking the value-added of technology in core processes. This thesis focuses on solving this general problem in the specific context of the United States Navy's Cryptologic Carry-On Program (CCOP). This study provides a demonstration of how a software suite that monitors process performance and its supporting technology can be implemented to provide ongoing return on investment information about CCOP technology. This follow-on research and trial implementation demonstrate how the Knowledge Value Added (KVA) Methodology that is embedded in the performance monitoring software is used to formulate a framework for extracting and analyzing performance parameters and measures of effectiveness for each CCOP system. KVA was used to measure the effectiveness and efficiency of CCOP systems and the impact they have on the Intelligence Collection Process (ICP) onboard the USS GONZALES. The analysis of the subprocess outputs involved in the ICP in common units of change, a price per unit of output is generated to allocate both cost and revenue at the subprocess level. With this level of financial detail, a return on investment (ROI) analysis can be conducted for each process, or asset.

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I. INTRODUCTION

A. PURPOSE / PROBLEM STATEMENT

The objective of this research is to provide a methodology by which program managers can make informed investment decisions by measuring performance metrics of technology embedded in core processes. This research applies this methodology by showing how it can by applied to a specific scenario using real-world data from afloat Cryptologic systems to show how this decision support model can be developed to assist in the POM/Budgeting process for OPNAV N20's acquisition of IW systems.

The Knowledge Value Added (KVA) methodology will be used to develop and analyze Measures of Performance (MOPs) which will be used to quantify and value the outputs. A cost and price per unit of output will be estimated using the KVA methodology which describes all outputs in common units. In addition, the market comparable valuation method will be used to estimate surrogate revenue pricing to enable an estimate of Return on Investment (ROI) for each CCOP system. In particular, this methodology will be applied to the Cryptologic Carry-On Program (CCOP) systems in use during an 18 month deployment of the USS GONZALES (DDG 66). ROI data will be analyzed and modeled using GaussSoft KVA Performance Accounting Modeling Software, with a near-real time operational model that can be configured to different naval platforms and CCOP configurations delivered at the conclusion of this research. The results should serve as inputs for analysis which can be used by decision makers to study alternative courses of action (COAs) for the deployment of CCOP systems.

B. BACKGROUND

This thesis represents the operational implementation of concepts that were previously developed by LCDR Cesar Rios, in concert with Dr. Tom Housel in his thesis titled, "Return on Investment Analysis of Information Warfare Systems." This research was conducted at the Naval Postgraduate School (NPS) to develop a methodology that provides a Return on Investment (ROI) for intelligence collection systems, as specifically applied to the Navy's Cryptologic Carry-On Program (CCOP).

This methodology is designed to provide project managers with a tool to evaluate system performance and the value associated with CCOP systems.

As described in the below abstract, the previous research conducted in, "Return on Investment Analysis of Information Warfare Systems," the initial focus of this effort was to build a foundation for using KVA to analyze performance metrics:

> The United States Navy's Cryptologic Carry-On Program Office manages a portfolio of Information Warfare (IW) systems. This research and case study demonstrate how the Knowledge Value Added (KVA) Methodology can be used to formulate a framework for extracting and analyzing performance parameters and measures of effectiveness for each system. KVA measures the effectiveness and efficiency of CCOP systems and the impact they have on the Intelligence Collection Process (ICP) on board U.S. Navy Ships. By analyzing the outputs of the subprocesses involved in the ICP in common units of change, a price per unit of output can be generated to allocate both cost and revenue at the subprocess level. With this level of financial detail, a return on investment (ROI) analysis can be conducted for each process, or asset[1].

This thesis is the follow-on research into the feasibility of a near-real time operational implementation of the above concepts. The methodologies and models that were previously developed were implemented during the course of our research. The transition from a concept to a real-world implementation creates the opportunity to refine the process and improve the overall product. Because this thesis focuses on implementation, this introductory chapter serves to highlight areas related to the problem, and the background and theoretical frameworks of each. The focus of this thesis is the application of concepts.

1. Navy ISR

The Naval Transformation Roadmap of 2003 sets direction for the future of Navy Intelligence, Surveillance, and Reconnaissance (ISR). The objective is to completely redesign Intelligence sensor capabilities, operational concepts, processes, and

[1] Cesar G. Rios, Jr., "Return on Investment Analysis of Information Warfare Systems" (MS Thesis, Naval Postgraduate School, 2005), 2.

organizational relationships and culture[2]. The previous focus emphasized primarily supporting tactical naval operations with little joint integration.

This redesign will allow Navy ISR to improve in two dramatic ways. First, it will allow Navy ISR to align with joint warfighter concepts and provide a greater overall capability to achieving national objectives in addition to meeting fleet requirements. Second, Navy ISR will move away from the traditional stove-piped, legacy systems into a standardized open architecture capable of national, joint, and fleet integration to conduct true network-centric operations.

This transformation presents a unique challenge to program managers who are continually asked to do more with less. Program managers require processes not just for the design and implementation of systems, but to determine if these systems are performing as expected. This is a major shift from the "black box" mentality of fielding systems with no real metrics to determine if they are contributing to overall mission success.

2. The Cryptologic Carry-On Program

The Cryptologic Carry-On Program (CCOP) is a product of the Advanced Cryptologic Systems Engineering program, which develops state-of-the-art Intelligence, Surveillance and Reconnaissance (ISR) capabilities in response to Combatant Command requirements for a quick-reaction surface, subsurface and airborne cryptologic carry-on capability[3]. CCOP systems are composed of several different subsystems, which for classification purposes will be referenced simply by a letter. The design and functionality of each system was analyzed as a part of this research and is represented in the data in Chapter II. However, these system specifics are outside of the scope of this paper to keep it at an unclassified level.

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[2] Department of the Navy. Naval Transformation Roadmap 2003: Assured Access & Power Projection…From the Sea. Washington: Dept. of the Navy, 2003. pp. 68-69.

[3] Cesar G. Rios, Jr., "Return on Investment Analysis of Information Warfare Systems" (MS Thesis, Naval Postgraduate School, 2005), 2.

CCOP systems have to ability to be configured in various ways depending on the capability needs of the platform it will be installed on. During this trial implementation, there was a standard CCOP load that was used to determine the Return on Investment

3. ROI Defined

Return on Investment (ROI) analysis is a method of building a financial business case. The term provides decision makers with the ability to determine the past and future performance of a system or organization as illustrated by the following formula[4].

$$PercentageROI = \frac{Earnings}{Investment}$$

For the above formula the "earnings" represent the difference between revenue and expenses, and "investment" represents the capital and assets of the organizations. The ROI then produces a metric to determine how efficiently the capital and assets are applied. A high ROI represents a high level of asset allocation towards the business objectives.

Clarence Nickerson, a Professor at the Harvard University Graduate School of Business Administration, writes "the value of a business property is dependent on what it can produce."[5] He also states, "in order to judge the value of the wealth created, we should take into account the property required to produce it."[6] In the private sector the use of ROI is often used as this metric to determine value of the services or products that are provided.

As the Navy transforms its ISR capabilities, this ROI metric provides project managers with a metric to evaluate the performance of systems and determine their value.

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[4] Nickerson, Clarence B. Accounting Handbook for Nonaccountants. 3rd Ed. New York: Van Nostrand Reinhold Co., 1986. p. 632.

[5] Nickerson, Clarence B. Accounting Handbook for Nonaccountants. 3rd Ed. New York: Van Nostrand Reinhold Co., 1986. p. 652.

[6] Ibid.

For the purpose of this trial implementation, Earnings is defined by the output of the CCOP system (reporting), and the Investment represents both the system and personnel costs.

The ROI calculation is more complex when applied to Navy ISR, and CCOP systems specifically. First, the above formula doesn't have common units. Investment can be in terms of dollars, but an intelligence report doesn't have a defined monetary value. To address part of this issue, analysis of cost of business intelligence reports providing comparable information was used to estimate a portion of the "value" of an intelligence report. Also, each subsystem has a different cost to build, and different inherent complexities resulting in different human costs to operate it. These issues can be handled more effectively by applying the Knowledge Value Added theory.

4. Knowledge Value Added

The Knowledge Value-Added (KVA) theory was created by Dr. Tom Housel (Naval Postgraduate School) and Dr. Valery Kanevsky (Agilent Labs). KVA is based on the assumption that humans and technology in organizations add value by taking inputs and changing them into outputs through core processes.[7]

KVA is a general theory for estimating the value added by knowledge assets, human and IT, using a methodology that is analytic and tautological. It is based on the premise that businesses and other organizations produce outputs (e.g., products and services) through a series of processes and subprocesses which change, in some manner, the raw inputs (i.e., labor into services, information into reports). KVA explains the changes made on the inputs by organizational processes to produce outputs in terms of the equivalent corresponding changes in entropy. The concept of entropy is defined in the American Heritage Dictionary as a "measure of the degree of disorder [or change] in a closed system." In the business context, it can be used as a surrogate for the amount of changes that a process makes to inputs to produce the resulting outputs. [8]

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[7] Housel, T. and Bell, A. Measuring and Managing Knowledge. Boston: McGraw-Hill, 2001. pp. 92-93.

[8] Housel, T. El Sawy, O., Zhong, J., and Rodgers, W. "Models for Mearsuring the Reutrn on Information Technology: A Proof of Concept Demonstration." 22nd International Conference on Inormation Systems. December, 2001. p. 13.

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C. RESEARCH OBJECTIVES

The objective of this research is to perform a trial implementation of a decision support model and methodology previously developed. This research can be used to assist in the budgeting process for the United States Navy's Chief of Naval Operations (OPNAV) CCOP Program Office (OPNAV N201) acquisition of information warfare systems. The trial implementation will assess the effectiveness and efficiency of a specific CCOP portfolio of IW systems deployed from March 2005 – August 2006 on the USS GONZALES (DDG 66). The resulting information can then be utilized to make sound financial decisions and projections in the acquisition and deployment of these systems.

D. METHODOLOGY

This thesis represents the application of the KVA methodology in a real-world situation. The data used in this study was collected from an 18-month deployment of the USS GONZALEZ from March 2005 – August 2006. This deployment presented a unique opportunity to have a long duration of system use spanning three different crews. This relatively long timeframe for a CCOP system to be deployed resulted in a greater volume of data than a typical six month deployment. This increased amount of data

[9] Housel, T. El Sawy, O., Zhong, J., and Rodgers, W. "Models for Mearsuring the Reutrn on Information Technology: A Proof of Concept Demonstration." 22nd International Conference on Inormation Systems. December, 2001. p. 13.

provided greater accuracy in calculating the output of the various CCOP systems, and how it impacted the ROI of the CCOP systems.

The methodology consists of the following:

1. Gathering current data of the CCOP program
2. Conducting Knowledge Value Added (KVA) analysis of the intelligence collection process based on the recent data
3. Developing a system to produce near real-time ROI calculations.

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II. METHODOLOGY OPERATIONAL IMPLEMENTATION: USS GONZALES (DDG 66)

A. INTRODUCTION

The original venture into KVA analysis for Navy CCOP systems, was initiated by then program officer of United States Navy's Chief of Naval Operations (CNO) Cryptologic Carry-On Program Office (OPNAV N201) LCDR Brian Prevo, who contacted fellow Information Warfare Officer and NPS student, LCDR Cesar Rios, concerning a CNO directive to focus on three goals for the following fiscal year: Efficiencies, Metrics, and Return on Investment.[10] LCDR Rios and Dr Thomas Housel constructed the initial framework for a proof of concept study to utilize KVA methodology to measure the ROI of CCOP systems. Taking this research as a new baseline, Lieutenant Ira Lambeth and Lieutenant Hubert Clapp worked to refine the model and test the feasibility of an operational implementation of the improved model. The following is a synopsis of their research.

1. Objective

The overall objective of this study was to build upon previous research using real-world data from afloat Cryptologic systems to develop a decision support model and methodology to assist in the POM/Budgeting process for OPNAV N20's acquisition of IW systems. A decision support model and methodology was developed to assist in the acquisitions process. This need was based on the results of previous research and how it can be adapted to various CCOP configurations. This will enable CCOP acquisition decision makers to use empirical data to evaluate the performance of individual CCOP systems for future investment.

2. Method

The Knowledge Value Added (KVA) methodology was used to develop and analyze Measures of Performance (MOPs) which were used to quantify and value the

[10] Department of the Navy. CCOP Program Briefing. Power Point. Washington: Dept. of the Navy, CCOP Program Office (OPNAV N201C), 25 April 2005.

outputs. A cost-per-output was calculated using KVA outputs in conjunction with market comparable pricing to determine a Return on Investment (ROI) for each system. In particular, this methodology was applied to the Cryptologic Carry-On Program (CCOP) systems in use during an 18 month deployment of the USS GONZALES (DDG 66).

B. HYPOTHESIS

The value of individual intelligence collection systems can be estimated for the purpose of determining their Return On Investment (ROI) by applying the Knowledge Value Added Methodology. Furthermore, a near-real time model for collection and evaluation of future CCOP capable platform deployments can be devised and delivered.

C. ANALYSIS AND DATA COLLECTION

1. The ICP and CCOP

Accurately determining the interaction of CCOP systems with their environment is essential to adequately simulating the ICP. Although there are slight differences between collection platforms, individual crews and geographical AOR tasking standards, there is a general level of the ICP that is common to all units.

Within the ICP, different CCOP systems fulfill different requirements and interact with the environment in different ways. Some systems serve as front ends to other systems and are applied over different processes and subprocesses of the ICP. Virtually all systems are at least partially automated in the search and collection processes, but there is no system that can operate completely independent of human interaction. The interaction and overlap between IT and Human operator makes the ICP modeling process complex and time consuming.

2. The Data Collection Challenge

As with the previous theoretical CCOP study, the highly classified and compartmented nature off the ISR system makes unclassified analysis difficult. Since the most measurable and common unit out output for any CCOP is a classified and compartmented report, the Klieglight (KL), developing an unclassified model for the KVA process is at best cumbersome and man hour intensive. During the course of this

research, each KL was hand parsed, line by line, in order to extract which individual CCOP systems had impacted it along the way. Information on the systems themselves were gathered from the previous CCOP research and then refined using inputs from the OPNAV N20 staff and the Space and Naval Warfare Command (SPAWAR). As before, Human cost, as public information, was gathered from sources such as the Stay Navy Website and the Center for Information Dominance (CID) training documentation.

D. MODELING THE USS READINESS ICP

The intelligence collection process (ICP) for tactical units has not changed in the updated KVA model. The following table is general enough as to be applicable to all ISR units and but specific enough to serve as the starting point for further KVA analysis.

	Subprocess Name	Subprocess Description
P1	**Review Request**	• **Determine if collection capability is available** • **Determine if further direction or info required**
P2	**Determine Op/Equip Mix**	• **Review directives and target information to determine type/category of target**
P3	**Input Search/Function into CCOP**	• **Assign search blocks and allocate system resources to each target**
P4	**Search/Collection Process**	• **Targeted or full spectrum search** • **Observe sensor data for target cues**
P5	**Target Data Acquisition/Capture**	• **Audio Routing** • **Record/Capture Data**
P6	**Target Data Processing**	• **Demodulate, decrypt, direction find (DF), or Geo-locate** • **Translate**
P7	**Target Data Analysis**	• **Human or IT-based analysis of captured data**
P8	**Format Data for Report Generation**	• **Input data into required reporting formats**
P9	**QC Report**	• **Check format, accuracy and adherence to tasking, regulations and laws**
P10	**Transmit Report**	• **Transmit via secure voice radio, secure internet relay chat, US Message Traffic Format**

Table 1. The Intelligence Collection Process (ICP).

Each subprocess can be further broken down into individual actions that may be required to perform the subprocess. Below is the breakdown of subprocess P6 Target Data Processing:

P6	**Target Data Processing**
	Human-based (no automation required)
	Manual copy directly into report
	Human translation & processing
	IT-based
	Direct transfer into report
	Demodulate
	All IT-based
	Human-enabled
	Decrypt
	All IT-based
	Human-enabled
	Direction finding
	Automatic - Local Line Of Bearing (LOB)
	Human-enabled - local LOB
	Human-enabled - B-rep request
	Geolocation
	Special processing

Table 2. Process P6 Activities.

1. USS GONZALES (DDG 66)

USS GONZALES is Flight I Arleigh Burke Destroyer which was outfitted with a typical CCOP suite for conducting ISR missions. The ship had three separate Information Warfare teams who operated in six month increments over her recent 18 month deployment. There were six different major CCOP systems installed which were responsible for all ICP during this time span. Daily Cryptologic tasking from higher authorities was received, a suitable collection plan was developed, and that plan was then input into the collection suites. It should be noted that only KL's and STRUM's were considered when examining formal system outputs. The table below illustrates the first ISR crew and the subprocesses within the ICP in which they perform:

IW Operator	Assigned to ICP Processes
Div Officer	1,2,9
Div LPO	2-7, 9
SigOp 1	3-7,9
SigOp 2	4-7
SigOp 3	4-7
ComOp1	8,10
ComOp2	8,10
ComOp3	8,10

Table 3. USS GONZALES ISR Crew 1.

USS GONZALES was outfitted with six CCOP systems (A, B, C, D, E and F) which operate in and across the following processes and subprocesses:

	Subprocess Name	CCOP Assigned
P1	Review Request/Tasking	A
P2	Determine Op/Equip Mix	A
P3	Input Search Function/Coverage Plan	A
P4	Search/Collection Process	A
P5	Target Data Acquisition/Capture	A
P5.1	Signal Type 1	B
P5.2	Signal Type 2	C
P5.3	Signal Type 3	D
P5.4	Signal Type 4	E
P6	Target Data Processing	
P6.1	Signal Type 1	B
P6.2	Signal Type 2	C
P6.3	Signal Type 3	D
P6.4	Signal Type 4	E
P7	Target Data Analysis	
P7.1	Signal Type 1	B
P7.2	Signal Type 2	C
P7.3	Signal Type 3	D
P7.4	Signal Type 4	E
P8	Format Data for Report Generation	A,F
P9	QC Report	A,F
P10	Transmit Report	F

Table 4. USS GONZALES CCOP Systems.

As shown in Table 6, all CCOP systems cover multiple processes. CCOP A is a very complex system, that provides various administrative, search, and transfer functions which enables the various other CCOP systems to be utilized in the ICP. Table 7 is a breakdown of CCOP A and its related components.

CCOP A (Example)	
Component	**Description/Functions**
Radio Frequency Management System	• RF management
Signal Acquisition System	• Energy Search
Audio Distribution System	• Audio Routing & Recording
Intermediate Frequency Signal Processing System	• Spectrum Display Operations • Signal Processing Applications
Control & Processing System	• Coverage Plan Creation/Management
Common Cryptologic Workstation (CCWS)	• Database Operations • JMCIS Applications • Cryptologic Unified Build Applications • Microsoft Applications • Signal Processing Applications

Table 5. CCOP A Components.

E. APPLYING KVA

As defined in the previous chapter as well as in LCDR Rios's earlier thesis, KVA uses a knowledge-based metaphor as a means to describe units of change in terms of the knowledge required to make the changes. The underlying assumptions of KVA have not changed and are listed again for the benefit of the reader.

1. KVA Assumptions

- Humans and technology in organizations take inputs and change them into outputs through core processes
- By describing all process outputs in common units (i.e., the knowledge required to produce the outputs) it is possible to assign revenue, as well as cost, to those processes at any given point in time.
- All outputs can be described in terms of the time required to learn how to produce them.
- Learning Time is measured in common units of time and is also a surrogate for knowledge. Thus, units of Learning Time can also be called Common Units of Output (**K**).

- Having a common unit of output makes it possible to compare all outputs in terms of cost per unit as well as price per unit, since revenue can now be assigned at the sub-organizational level.
- Once cost and revenue stream have been assigned to sub-organizational outputs, normal accounting and financial performance and profitability metrics can be applied to them.

2. Case Study Assumptions and Data

The following assumptions and data apply to the USS GONZALES – KVA trial implementation case study

a. Assumptions

Proxy Revenue Assumptions: The proxy revenue assumption states that not for profit agencies can derive certain inferences from comparable outputs of commercial entities. They are:

1. First, if the processes used to produce the outputs of both organizations are comparable, then the outputs of the two must also be comparable.
2. Second, if market forces have placed a "value" or price-per-unit to the comparable commercial outputs yielding a revenue stream for the commercial entity, that price-per-unit can also be applied to the not-for-profit case.
3. Lastly, the derived price-per-unit can be used to develop an analytical or hypothetical revenue stream for the not-for-profit organization.

The proxy revenues estimates are taken from the same nine sources as in LCDR Rios proof of concept study. Additionally it should be noted that the price of the Business Intelligence products was unchanged over the past year and a half. Figure 2 highlights two of these sources.

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Price per Global Intelligence Report/Assignment is approximately $5,000 (US)

Figure 1. Intelligence Price-per-Unit Benchmarking Sample.[11]

Output Assumptions: As stated earlier, although a variety of outputs were produced by the IW operators and the CCOP systems themselves, only information gathered from KL's and STRUMS's were considered as standard outputs for this trial implementation. It should also be noted that each KL of precedence immediate was given a value of 1.0, precedence routine a value of 0.80, stand alone geo-locations a value of 0.75, and standalone tips and flashes a value of 0.5.

Other Assumptions: *IT Learning Time.* The same process for determining a Time to Learn (TTL) estimate was used in both studies. However, all TTL numbers were thoroughly reviewed and updated for each CCOP system. Additionally, TTL estimates had to be calculated from scratch for two CCOP systems either not covered in

[11] Data for IHL Consulting Group was gathered from the 2005 IGL Consulting Group Research Price List which is available from www.ihlservices.com

Data for J.C. Owens Global Consulting, LLC was furnished by Mr. Israel Mbachu, CFE, CII, Principal Partner at J.C. Owens Global Consulting, LLC. Email dated 09 September 2005.

the first study, or assumed to be part of a larger CCOP system. In all cases, academic authorities, system subject matter experts and system technical documents were consulted to obtain TTL estimates. Figure 3 illustrates the breakout for CCOP C, a listing of TTL estimates for all CCOP systems used in this study can be found in Appendix A.

CCOP C Learning Time Derivation Example

To determine the learning time of CCOP C, the team first dissected the system into its basic functional components. CCOP C is the AN/SSQ-120(V) Transportable-Radio Direction Finder (T-RDF). T-RDF provides a low-cost Medium/High/Very High/Ultra High Frequency (MF/HF/VHF/UHF) Direction Finding (DF) capability to selected U.S. Navy ships. T-RDF has two major components, the receiving equipment and the processing unit.

To analyze the system and determine its time to learn, the team consulted Dr. Richard Adler, an authority on signals intelligence (SIGINT) systems and antenna technologies. It was assumed that, as a baseline, the "average learner" to be taught the functions of T-RDF would have an undergraduate degree in a related technical field such as Electrical Engineering. Dr. Adler suggested that the underlying disciplines that would have to be learned are:

–Basic RF Theory (66 days)
–EM Theory/Formal EM (198 days)
–Basic Communications Theory (132 days)
–Propagation Theory (66 days)
–Antenna Theory (66 days)
–Basic Radio Direction Finding (66 days)

Aggregating the results, an estimate of 594 days of learning time would be required for the average learner to learn how to produce the outputs of CCOP C.

Figure 2. CCOP C Learning Time.[12] [13]

[12] Department of the Navy. Vision…Presence…Power: A Program Guide to the U.S. Navy – 2002 Edition. Washington: Dept. of the Navy, 2002. Chapter 3.

13 Dr. Richard Adler is a Research Associate Professor in Department of Electrical and Computer Engineering at the Naval Postgraduate School. He also holds positions in the Research Committee and is the Supervisor of the Signal Enhancement Lab. Dr. Adler has 31 years of experience in undergraduate and graduate teaching and thesis advising, 29 years in design and analysis of VLF-UHF tactical, strategic, DF and broadcast antennas, 31 years in EM numerical analysis of the effects of platforms and environment on the performance of antennas, and 26 years Hands-On-Workshops on Numerical Antenna Modeling for wire antennas, reflector antennas and general scattering shapes. He is a Registered Professional Engineer in California.

b. Data

Length of Sample Period: The sample period for this analysis was the entire 18 month deployment period, broken into individual ISR crew 6 month segments. Annual cost data is adjusted to reflect the segment period.

Cost Assumptions: Cost of each individual ISR crew was derived from the U.S. Navy, Stay Navy website for Fiscal Year 2007 with allowances calculated for FT Gordon, GA or FT Meade, MD depending on each individual augment. Operator re-enlistment bonus was also based on the rank and rate of each crew member. Equipment costs were derived from annual cost data provided by the OPNAV N20 staff. Equipment costs were modified in this study to include not only installation and training costs, but also amortization or, the total operational cost of the program**.**

Figures representing on the job training, Navy A and C schools and NEC specific bonus used in the Human Capital calculations follow.

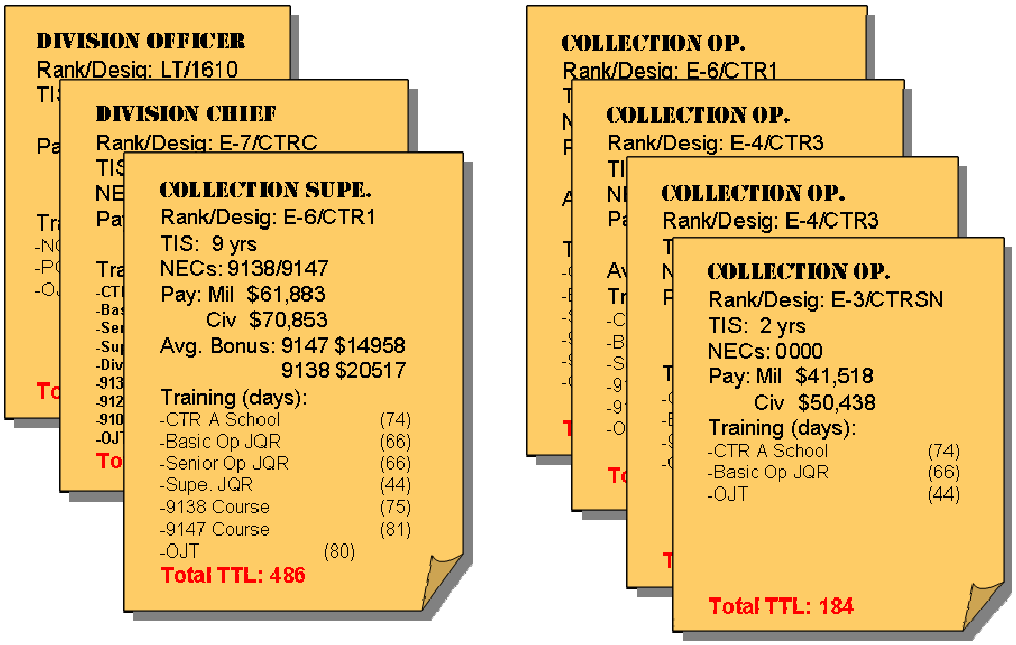

Figure 3. Sample Operator Data Sheets.

The following tables contain the actual case data for the cost of human assets for USS Gonzales Crew 1:

Asset	Avg Annual Unit Costs	Budget (Cost) per Sample Pd (80%) Multiplier
Div Officer	$59,328	$23,731
Div LPO	$53,098	$21,239
SigOp 1	$38,925	$15,570
SigOp 2	$38,925	$15,570
SigOp 3	$38,925	$15,570
ComOp1	$47,436	$18,974
ComOp2	$37,668	$15,067
ComOp3	$33,564	$13,426
Total Human	$59,328	$139,148

Table 6. USS GONZALES Crew 1 Human Capital Cost Data.

The total amount of days of on-the-job training and job experience of the human assets are shown in Table 9.

Operator	Time in Service (Days)	Pre-Deploy-ment Training (Days)	On-Job Training (Days)	Totals
Div Officer	730.00	15	292	1,037
Div LPO	4124.50	15	524	4,664
SigOp 1	1131.50	30	486	1,648
SigOp 2	1131.50	30	366	1,528
SigOp 3	1131.50	30	325	1,487
ComOp1	4124.50	20	325	4,470
ComOp2	1898.00	20	219	2,137
ComOp3	1131.50	20	184	1,336

Table 7. USS GONZALES Crew 1 Operator Training Time (Days).

Information Technology: Detailed cost information was also gathered for the USS GONZALES CCOP systems. Cost data, shown below, was derived from annual budget estimates. Complete cost data, to include Amortization data, is included in Appendix A.

Element	Avg Annual Unit Costs	Budget (Cost) per Sample Pd
CCOP A	$158,333	$83,500
CCOP B	$29,167	$16,917
CCOP C	$54,545	$30,606
CCOP D	$40,000	$24,500
CCOP E	$35,000	$19,833
CCOP F	$58,000	$29,000
TOTAL IT		$155,523

Table 8. USS GONZALES Systems Cost Data.

Each CCOP system was broken down into subsystem and subprocess levels and TTL estimates were then calculated by interviewing system subject matter experts, academic authorities and consulting technical documents. The TTL estimate goal was to determine how many days it would take the average IW operator to learn how to perform each CCOP subsystem and subprocess operation. Aggregated estimations used for each CCOP system are shown below, complete breakouts are given as part of Appendix A.

CCOP A Aggregated Time to Learn =	**3,443**
CCOP B Time to Learn =	**936**
CCOP C Time to Learn =	**594**
CCOP D Time to Learn =	**1,825**
CCOP E Time to Learn =	**851**
CCOP F Time to Learn =	**570**

Table 9. CCOP System Learning-Time.

3. KVA Steps

For illustrative purposes, subprocesses P5 and P8 will be used to demonstrate the steps of the KVA calculation process. Appendix A contains the full analysis for each subprocess. Standard KVA definitions are listed in the appropriate sections.

a. Step One: Estimate Process Time- to-Learn

(1) Definitions:

Time to Learn ($\mathbf{t_L}$) is the time it would take the average learner to learn how to produce a single subprocess output.

Human Time to Learn (t_{LH}) is the time it would take the average learner to learn the human-specific portions of the subprocess required to produce a single subprocess output. In this case factors such as time-in-service, schooling, on the job training, and pre-deployment training of each operator were used to estimate the human time to learn.

IT Time to Learn (t_{LIT}) is the time it would take the same average learner to learn how to produce the outputs produced by the IT systems in a single subprocess output cycle. In this case, subject matter experts in the functional fields of each system were consulted to estimate the IT time to learn as exampled in Figure 3.

% Automation is the percent of a process that is automated by information technology.

(2) Description: Total subprocess time to learn is calculated by summing the total human time to learn and the total CCOP time to learn. The human TTL for each subprocess is a sum of pre-deployment training days, on the job training days, process specific training days, and a percentage of the operators' time in service days. This sum is then reduced by the percent of automation in the subprocess provided by the CCOP system. The total time to learn IT, is a combination of the days removed from human TTL due to percent automation and the aggregate CCOP TTL divided by the number of subprocesses over which it is applied.

	Subproc Name	CCOP Assigned	Process tLH Training (days)	Other Relevant tLH (days)	TOTAL Tlh (days)	Tot tLH-% auto (days)	CCOP tLIT (days)	Avg % Auto	Tot tLIT plus % Auto (days)	Tot tL for 1 Process Output (days)
P5	**Target Data Acquisition/Capture**	A	**16**	1613	1629	1059	492	35%	605.86	1,664.42
P5.1	**Signal Type 1**	B					312	35%	426	426
P5.2	**Signal Type 2**	C					198	35%	312	312
P5.3	**Signal Type 3**	D					608	35%	722.33	722.33
P5.4	**Signal Type 4**	E					284	35%	397.67	397.67
P8	**Formatting for Report Generation**	A,F	**10**	5718	5728	2864	682	50%	3,545.98	6,410.10

Table 10. P5 and P8 Time to Learn.

b. Steps Two and Three: Calculate the K Produced by IT and Human Assets. Find the Total K for Each Subprocess

(1) Definitions:

K is the descriptive term chosen for the common units of output estimated by KVA.

Executions (Ex) are the average number of times a process asset, human or IT, produced an individual subprocess output.

$\mathbf{K_H}$ is the common units of output attributed to human-asset contribution.

$\mathbf{K_{IT}}$ is the common units of output attributed to IT-asset contribution.

$\mathbf{K_P}$ is the total common units of output for each subprocess.

(2) Formulas:

Total subprocess-asset output: $\mathbf{K_{Asset} = (Ex_{Asset})\ (t_L)}$

Total subprocess output: $\mathbf{K_P = K_H + K_{IT}}$

Total process output: $\mathbf{K_{TOT} = \Sigma(K_P)}$

(3) Description: The total **K** of any subprocess is the summation of the total **K** of it's human and IT components. In order to calculate human and IT **K**, we multiply the TTL of each operator or CCOP system by its corresponding number of executions, or times fired. The total **K** for humans and IT is then the sum of all operators and all CCOP's **K** respectively.

Total Output per Subprocess for Sample Period - Including Automation				
Asset	# executions by Asset 5	Total K *P4*	# executions by Asset *P8*	Total K *P8*
Div Officer	0	0.00	0	0.00
Div LPO	26	27287.43	0	0.00
SigOp 1	26	27287.43	0	0.00
SigOp 2	32	34109.28	0	0.00
SigOp 3	32	34109.28	0	0.00
ComOp1	0	0.00	39	110745.97
ComOp2	0	0.00	39	110745.97
ComOp3	0	0.00	39	110745.97
	P5 Human K	**122793.42**	**P8 Human K**	**332237.92**
CCOP A	13	7876.13	58	205666.67
CCOP B	13	5537.99	0	0.00
CCOP C	32	9983.97	0	0.00
CCOP D	0	0.00	0	0.00
CCOP E	103	40959.58	0	0.00
CCOP F	0	0.00	58	205666.67
	P5 IT K	**70597.66**	**P8 IT K**	**411333.35**
	Total P5 K	**193391.09**	**Total P8 K**	**743571.27**

Table 11. P5 and P8 Total K by Asset.

c. Steps Four and Five: Derive Proxy Revenue Stream and Develop the Value Equation Numerator by Assigning Revenue Streams to Subprocesses.

(1) Definitions:

Market Comparable Price per Unit is the notional price per unit allocated to the outputs of non-profit organizations based on the market price per unit of the comparable outputs of a similar commercial organization.

% K is percent of the total K produced by an individual subprocess or asset.

(2) Formulas:

Proxy Revenue: $\mathbf{R_{TOT} = (Total\ \#\ of\ Process\ Outputs)\ (Market\ Comp.\ Price\ per\ Unit)}$

% of Total **K** per Subprocess: $\mathbf{\%\ K_P = (K_P / K_{TOT})\ x\ 100\%}$

Subprocess Revenue Allocation: $\mathbf{R_P = \%K_P\ x\ R_{TOT}}$

(3) Description: First, utilizing the Market Comparables approach, the total number of ICP outputs is multiplied by the average market price-per-unit to yield a Proxy Revenue for the USS READINESS ICP.

Proxy Revenue Assumptions	
Market Comparable Price Per Unit (avg)	**$ 3,800**
Avg# Reports executed/sample pd	**$ 116**
Avg Proxy for Revs - Sample Pd (R_{TOT})	**$ 440,800**

Table 12. USS GONZALES ICP Proxy Revenue Assumption.

Next, the percent of the total process **K** produced by each subprocess is calculated.

	Subprocess Name	K for IT (automation & infras)	K for Humans	Total K	% of Total K per subprocess
P5	**Target Data Acquisition/Capture**	70,597.66	122,793.42	193,391.09	6.36%
P8	**Format Data for Report Generation**	411,333.35	332,237.92	743,571.27	24.44%
		1,578,276.27	1,464,337.57	3,042,613.84	100.00%

Table 13. P5 and P8 Percent K.

Revenues can now be assigned to subprocesses, people and IT based on their individual **%K**:

	Subprocess	K for Humans	Total K	% of Total K per subprocess	Proxy Revenue Assigned to Subprocess ($US)	% of Total K for Human per Subprocess	Proxy Revenue Assigned to Human K ($US)
P5	**Target Data Acquisition/Capture**	122,793.42	193,391.09	6.36%	$28,018	4.04%	$17,790
P8	**Format Data for Report Generation**	332,237.92	743,571.27	24.44%	$107,725	10.92%	$48,133
		1,464,337.57	3,042,613.84	100.00%	$440,800	48.13%	$212,147

Table 14. P5 and P8 Proxy Revenue Allocation for Human Contribution.

	Subprocess Name	K for IT (automation & infras)	Total K	% of Total K for CCOP A	Proxy Revenue Assigned to CCOP A Process K ($US)	% of Total K for CCOP B	Proxy Revenue Assigned to CCOP B Process K ($US)
P5	**Target Data Acquisition/Capture**	70,597.66	193,391.09	0.26%	$1,141	0.18%	$802
P8	**Format Data for Report Generation**	411,333.35	743,571.27	6.76%	$29,796	-	-
		1,578,276.27	3,042,613.84	34.17%	$150,616	0.59%	$2,581

Table 15. P5 and P8 Proxy Revenue Allocation for CCOP A & B Contribution.

	Subprocess Name	K for IT (automation & infras)	Total K	% of Total K for CCOP C	Proxy Revenue Assigned to CCOP C Process K ($US)	% of Total K for CCOP D	Proxy Revenue Assigned to CCOP D Process K ($US)
P5	**Target Data Acquisition/Capture**	70,597.66	193,391.09	0.53%	$2,350	0.00%	$0.00
P8	**Format Data for Report Generation**	411,333.35	743,571.27	-	-	-	-
		1,578,276.27	3,042,613.84	1.76%	$7,747	0.00%	$0.00

Table 16. P5 and P8 Proxy Revenue Allocation for CCOP C & D Contribution.

	Subprocess Name	K for IT (automation & infras)	Total K	% of Total K for CCOP E	Proxy Revenue Assigned to CCOP E Process K ($US)	% of Total K for CCOP F	Proxy Revenue Assigned to CCOP F Process K ($US)
P5	**Target Data Acquisition/Capture**	70,597.66	193,391.09	1.35%	$5,934		
P8	**Format Data for Report Generation**	411,333.35	743,571.27			6.76%	$29,796
		1,578,276.27	3,042,613.84	4.35%	$13,245	11.01%	$48,531

Table 17. P5 and P8 Proxy Revenue Allocation for CCOP E & F Contribution.

d. Step Six: Develop the Value Equation Denominator by Assigning Costs to Subprocesses

(1) Description: Costs are assigned directly to each subprocess based on the assets producing outputs in each. The cost of human assets that are assigned to multiple processes are divided proportionally based upon individual operators percentage of time spent on that subprocess. IT assets that are assigned to multiple processes are divided evenly throughout those subprocesses. The cost of human and IT assets are summed in each subprocess to yield the total cost per subprocess ($\mathbf{C_P}$).

	Subprocess Name	Proxy Revenue Assigned to Subprocess ($US)	Cost Assigned to Subprocess ($US)	Proxy Revenue Assigned to Human K ($US)	Cost Assigned to Human K ($US)
P5	**Target Data Acquisition/Capture**	$28,018	$57,694	4.0358%	$17,790
P8	**Format Data for Report Generation**	$107,725	$64,316	10.9195%	$48,133
		$440,800	$343,504	48.1276%	$212,147

Table 18. P5 and P8 Total Cost Allocation & Human Cost Allocation.

	Subprocess Name	Proxy Revenue Assigned to CCOP A Process K ($US)	Cost Assigned to CCOP A Process K ($US)	Proxy Revenue Assigned to CCOP B Process K ($US)	Cost Assigned to CCOP B Process K ($US)	Proxy Revenue Assigned to CCOP C Process K ($US)	Cost Assigned to CCOP C Process K ($US)
P5	**Target Data Acquisition/ Capture**	$1,141	$11,929	$802	$5,639	$2,350	$10,202
P8	**Format Data for Report Generation**	$29,796	$11,929				
		$150,616	$83,500	$2,581	$16,917	$7,747	$30,606

Table 19. P5 and P8 Cost Allocation for CCOP A, B and C.

Proxy Revenue Assigned to CCOP D Process K ($US)	Cost Assigned to CCOP D Process K ($US)	Proxy Revenue Assigned to CCOP E Process K ($US)	Cost Assigned to CCOP E Process K ($US)	Proxy Revenue Assigned to F Process K ($US)	Cost Assigned to F Process K ($US)
$0.00	$8,167	$5,040	$6,611		
				$29,796	$9,667
$0.00	$24,500	$13,245	$19,833	$48,531	$29,000

Table 20. P5 and P8 Cost Allocation for CCOP D, E, and F.

e. Steps Seven, Eight and Nine: Calculate the Value Equation (ROI)

(1) Definitions:

ROK is the Return on Knowledge, a productivity ratio
ROKA is the Return on Knowledge Assets, a profitability ratio
ROKI is the Return on Knowledge Investment, the value equation

(2) Formulas:

Total Return on Knowledge: **ROK = Revenue / Cost**

Subprocess ROK (as percentage): $\mathbf{ROK_P = (R_P / C_P) \times 100\%}$

Subprocess ROKA: $\mathbf{ROKA_P = (R_P - C_P) / (\%K_P \times R_{TOT})}$

Subprocess ROKI: $\mathbf{ROKI_P = (R_P - C_P) / (C_P)}$

(3) Description: The revenues and costs assigned to subprocesses, people and IT are used to calculate the value equations.

KVA Metrics for Total K					
	Subprocess Name	ROK as Ratio	ROK as %	ROKA	ROKI
P5	**Target Data Acquisition/Capture**	0.49	48.56%	-105.92%	-51.44%
P8	**Format Data for Report Generation**	1.67	167.49%	40.30%	67.49%
Metrics for Aggregated		12.34	1234.21%	-224.73%	234.21%

Table 21. P5 and P8 KVA Metrics.

Note: For Human and IT ROK, ROKA, and ROKI, the Cost and Revenue of each asset is substituted for subprocess cost and revenues in the value equations.

4. KVA Results for USS GONZALES ICP for all Three Crews

KVA Metrics for Total K						KVA Metrics for Human K					
	Subprocess Name	ROK as Ratio	ROK as %	ROKA	ROKI		Subprocess Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/Review Request/Tasking	1.04	104.42%	4.23%	4.42%	P1	Receive/Review Request/Tasking	0.74	73.70%	-35.68%	-26.30%
P2	Determine Op/Equip Mix	1.44	143.58%	30.35%	43.58%	P2	Determine Op/Equip Mix	1.75	174.88%	42.82%	74.88%
P3	Load Search Func/Coverage Plan	1.80	179.70%	44.35%	79.70%	P3	Load Search Func/Coverage Plan	2.72	271.98%	63.23%	171.98%
P4	Search/Collection	3.98	397.88%	74.87%	297.88%	P4	Search/Collection	3.19	318.78%	68.63%	218.78%
P5	Target Data Acquisition/Capture	0.49	48.56%	-105.92%	-51.44%	P5	Target Data Acquisition/Capture	1.17	117.45%	14.86%	17.45%
P6	Target Data Processing	0.51	50.85%	-96.64%	-49.15%	P6	Target Data Processing	1.27	127.09%	21.32%	27.09%
P7	Target Data Analysis	0.54	54.44%	-83.68%	-45.56%	P7	Target Data Analysis	1.11	110.64%	9.62%	10.64%
P8	Format Data for Report Generation	1.67	167.49%	40.30%	67.49%	P8	Format Data for Report Generation	1.13	112.67%	11.25%	12.67%
P9	QC Report	0.68	68.24%	-46.54%	-31.76%	P9	QC Report	0.88	88.43%	-13.09%	-11.57%
P10	Transmit Report	0.98	97.87%	-2.18%	-2.13%	P10	Transmit Report	0.34	34.49%	-189.98%	-65.51%
Metrics for Aggregated		13.13	1313.05%	-140.86%	313.05%		Metrics for Aggregated	14.30	1430.10%	-7.03%	430.10%

KVA Metrics for CCOP A K						KVA Metrics for CCOP B K					
	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI		Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking	1.29	128.87%	22.40%	28.87%	P1	Receive/ Review Request/ Tasking				
P2	Determine Op/Equip Mix	1.22	122.44%	18.33%	22.44%	P2	Determine Op/Equip Mix				
P3	Load Search Func/ Coverage Plan	1.39	139.18%	28.15%	39.18%	P3	Load Search Func/ Coverage Plan				
P4	Search/ Collection	5.60	560.28%	82.15%	460.28%	P4	Search/ Collection				
P5	Target Data Acquisition/Capture	0.10	9.57%	-945.40%	-90.43%	P5	Target Data Acquisition/Capture	0.14	14.23%	-602.82%	-85.77%
P6	Target Data Processing					P6	Target Data Processing	0.15	15.20%	-557.76%	-84.80%
P7	Target Data Analysis					P7	Target Data Analysis	0.16	16.34%	-512.16%	-83.66%
P8	Format Data for Report Generation	2.50	249.79%	59.97%	149.79%	P8	Format Data for Report Generation				
P9	QC Report	0.53	52.53%	-90.36%	-47.47%	P9	QC Report				
P10	Transmit Report					P10	Transmit Report				
Metrics for Aggregated		12.63	1262.65%	-824.76%	562.65%	Metrics for Aggregated		0.46	45.77%	-1672.75%	-254.23%

KVA Metrics for CCOP C K					
	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking				
P2	Determine Op/Equip Mix				
P3	Load Search Func/ Coverage Plan				
P4	Search/ Collection				
P5	Target Data Acquisition/Capture	0.23	23.04%	-334.04%	-76.96%
P6	Target Data Processing	0.25	25.19%	-296.92%	-74.81%
P7	Target Data Analysis	0.28	27.70%	-261.04%	-72.30%
P8	Format Data for Report Generation				
P9	QC Report				
P10	Transmit Report				
Metrics for Aggregated		0.76	75.93%	-892.00%	-224.07%

KVA Metrics for CCOP D K					
	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking				
P2	Determine Op/Equip Mix				
P3	Load Search Func/ Coverage Plan				
P4	Search/ Collection				
P5	Target Data Acquisition/Capture	-	0.00%	#DIV/0!	-100.00%
P6	Target Data Processing	-	0.00%	#DIV/0!	-100.00%
P7	Target Data Analysis	-	0.00%	#DIV/0!	-100.00%
P8	Format Data for Report Generation				
P9	QC Report				
P10	Transmit Report				
Metrics for Aggregated		-	0.00%	#DIV/0!	-300.00%

KVA Metrics for CCOP E K					
	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking				
P2	Determine Op/Equip Mix				
P3	Load Search Func/ Coverage Plan				
P4	Search/ Collection				
P5	Target Data Acquisition/Capture	0.90	89.76%	-11.41%	-10.24%
P6	Target Data Processing	0.96	96.35%	-3.79%	-3.65%
P7	Target Data Analysis	1.04	104.00%	3.85%	4.00%
P8	Format Data for Report Generation				
P9	QC Report				
P10	Transmit Report				
Metrics for Aggregated		2.90	290.10%	-11.36%	-9.90%

KVA Metrics for CCOP F K					
	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking				
P2	Determine Op/Equip Mix				
P3	Load Search Func/ Coverage Plan				
P4	Search/ Collection				
P5	Target Data Acquisition/Capture				
P6	Target Data Processing				
P7	Target Data Analysis				
P8	Format Data for Report Generation	3.08	308.23%	67.56%	208.23%
P9	QC Report	0.65	64.82%	-54.27%	-35.18%
P10	Transmit Report	1.29	128.99%	22.47%	28.99%
Metrics for Aggregated		5.02	502.05%	35.76%	202.05%

Table 22. KVA Results for USS GONZALES, Crew 1

KVA Metrics for Total K						KVA Metrics for Human K					
	Subprocess Name	ROK as Ratio	ROK as %	ROKA	ROKI		Subprocess Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/Review Request/Tasking	0.65	65.09%	-53.63%	-34.91%	P1	Receive/Review Request/Tasking	0.46	45.94%	-117.66%	-54.06%
P2	Determine Op/Equip Mix	0.90	89.50%	-11.73%	-10.50%	P2	Determine Op/Equip Mix	1.09	109.01%	8.27%	9.01%
P3	Load Search Func/Coverage Plan	1.58	158.12%	36.76%	58.12%	P3	Load Search Func/Coverage Plan	2.90	290.42%	65.57%	190.42%
P4	Search/Collection	3.40	340.16%	70.60%	240.16%	P4	Search/Collection	3.05	304.89%	67.20%	204.89%
P5	Target Data Acquisition/Capture	0.69	68.51%	-45.95%	-31.49%	P5	Target Data Acquisition/Capture	1.09	109.03%	8.28%	9.03%
P6	Target Data Processing	0.70	70.43%	-41.98%	-29.57%	P6	Target Data Processing	1.07	107.30%	6.80%	7.30%
P7	Target Data Analysis	0.72	71.68%	-39.51%	-28.32%	P7	Target Data Analysis	0.91	91.30%	-9.53%	-8.70%
P8	Format Data for Report Generation	0.94	93.68%	-6.75%	-6.32%	P8	Format Data for Report Generation	0.62	61.73%	-61.99%	-38.27%
P9	QC Report	0.54	53.91%	-85.50%	-46.09%	P9	QC Report	0.81	81.30%	-23.00%	-18.70%
P10	Transmit Report	0.74	73.82%	-35.46%	-26.18%	P10	Transmit Report	0.12	12.10%	-726.34%	-87.90%
Metrics for Aggregated		10.85	1084.91%	-213.15%	84.91%		Metrics for Aggregated	12.13	1213.02%	-782.40%	213.02%

KVA Metrics for CCOP A K						KVA Metrics for CCOP B K					
	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI		Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking	0.80	80.33%	-24.48%	-19.67%	P1	Receive/ Review Request/ Tasking				
P2	Determine Op/Equip Mix	0.76	76.33%	-31.02%	-23.67%	P2	Determine Op/Equip Mix				
P3	Load Search Func/ Coverage Plan	1.00	100.03%	0.03%	0.03%	P3	Load Search Func/ Coverage Plan				
P4	Search/ Collection	4.13	412.58%	75.76%	312.58%	P4	Search/ Collection				
P5	Target Data Acquisition/Capture	0.55	54.92%	-82.08%	-45.08%	P5	Target Data Acquisition/Capture	0.54	53.79%	-85.90%	-46.21%
P6	Target Data Processing					P6	Target Data Processing	0.65	64.51%	-55.01%	-35.49%
P7	Target Data Analysis					P7	Target Data Analysis	0.69	69.45%	-43.99%	-30.55%
P8	Format Data for Report Generation	1.58	158.17%	36.78%	58.17%	P8	Format Data for Report Generation				
P9	QC Report	0.36	36.26%	-175.82%	-63.74%	P9	QC Report				
P10	Transmit Report					P10	Transmit Report				
Metrics for Aggregated		9.19	918.61%	-200.83%	218.61%	Metrics for Aggregated		1.88	187.75%	-184.90%	-112.25%

KVA Metrics for CCOP C K					
	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking				
P2	Determine Op/Equip Mix				
P3	Load Search Func/ Coverage Plan				
P4	Search/ Collection				
P5	Target Data Acquisition/Capture	0.00	0.32%	-31086.78%	-99.68%
P6	Target Data Processing	0.00	0.41%	-24345.97%	-99.59%
P7	Target Data Analysis	0.00	0.45%	-22130.96%	-99.55%
P8	Format Data for Report Generation				
P9	QC Report				
P10	Transmit Report				
Metrics for Aggregated		0.01	1.18%	-77563.71%	-298.82%

KVA Metrics for CCOP D K					
	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking				
P2	Determine Op/Equip Mix				
P3	Load Search Func/ Coverage Plan				
P4	Search/ Collection				
P5	Target Data Acquisition/Capture	1.46	145.99%	31.50%	45.99%
P6	Target Data Processing	1.63	162.88%	38.61%	62.88%
P7	Target Data Analysis	1.71	170.67%	41.41%	70.67%
P8	Format Data for Report Generation				
P9	QC Report				
P10	Transmit Report				
Metrics for Aggregated		4.80	479.54%	111.52%	179.54%

KVA Metrics for CCOP E K					
	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking				
P2	Determine Op/Equip Mix				
P3	Load Search Func/ Coverage Plan				
P4	Search/ Collection				
P5	Target Data Acquisition/Capture	0.22	22.32%	-348.12%	-77.68%
P6	Target Data Processing	0.27	27.09%	-269.13%	-72.91%
P7	Target Data Analysis	0.29	29.29%	-241.39%	-70.71%
P8	Format Data for Report Generation				
P9	QC Report				
P10	Transmit Report				
Metrics for Aggregated		0.79	78.70%	-858.64%	-221.30%

KVA Metrics for CCOP F K					
	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking				
P2	Determine Op/Equip Mix				
P3	Load Search Func/ Coverage Plan				
P4	Search/ Collection				
P5	Target Data Acquisition/Capture				
P6	Target Data Processing				
P7	Target Data Analysis				
P8	Format Data for Report Generation	1.95	195.18%	48.77%	95.18%
P9	QC Report	0.45	44.74%	-123.52%	-55.26%
P10	Transmit Report	1.81	181.28%	44.84%	81.28%
Metrics for Aggregated		4.21	421.20%	-29.91%	121.20%

Table 23. KVA Results for USS GONZALES, Crew 2

KVA Metrics for Total K						KVA Metrics for Human K					
	Subprocess Name	ROK as Ratio	ROK as %	ROKA	ROKI		Subprocess Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/Review Request/Tasking	1.04	104.28%	4.10%	4.28%	P1	Receive/Review Request/Tasking	0.74	73.60%	-35.87%	-26.40%
P2	Determine Op/Equip Mix	1.43	143.38%	30.26%	43.38%	P2	Determine Op/Equip Mix	1.75	174.64%	42.74%	74.64%
P3	Load Search Func/Coverage Plan	1.94	193.88%	48.42%	93.88%	P3	Load Search Func/Coverage Plan	2.99	298.57%	66.51%	198.57%
P4	Search/Collection	14.32	1431.81%	93.02%	1331.81%	P4	Search/Collection	12.31	1231.17%	91.88%	1131.17%
P5	Target Data Acquisition/Capture	1.98	197.62%	49.40%	97.62%	P5	Target Data Acquisition/Capture	4.42	442.32%	77.39%	342.32%
P6	Target Data Processing	2.34	233.98%	57.26%	133.98%	P6	Target Data Processing	4.56	455.92%	78.07%	355.92%
P7	Target Data Analysis	2.47	247.38%	59.58%	147.38%	P7	Target Data Analysis	4.00	399.72%	74.98%	299.72%
P8	Format Data for Report Generation	5.34	534.30%	81.28%	434.30%	P8	Format Data for Report Generation	4.32	431.59%	76.83%	331.59%
P9	QC Report	2.42	242.06%	58.69%	142.06%	P9	QC Report	3.25	324.61%	69.19%	224.61%
P10	Transmit Report	3.13	312.94%	68.04%	212.94%	P10	Transmit Report	1.10	110.31%	9.35%	10.31%
Metrics for Aggregated		36.42	3641.62%	550.05%	2641.62%		Metrics for Aggregated	39.42	3942.45%	551.07%	2942.45%

KVA Metrics for CCOP A K						KVA Metrics for CCOP B K					
	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI		Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking	1.29	128.69%	22.29%	28.69%	P1	Receive/ Review Request/ Tasking				
P2	Determine Op/Equip Mix	1.22	122.27%	18.22%	22.27%	P2	Determine Op/Equip Mix				
P3	Load Search Func/ Coverage Plan	1.44	144.43%	30.76%	44.43%	P3	Load Search Func/ Coverage Plan				
P4	Search/ Collection	18.70	1870.42%	94.65%	1770.42%	P4	Search/ Collection				
P5	Target Data Acquisition/Capture	0.01	1.08%	-9182.45%	-98.92%	P5	Target Data Acquisition/Capture	0.01	1.09%	-9058.97%	-98.91%
P6	Target Data Processing					P6	Target Data Processing	0.01	1.30%	-7595.32%	-98.70%
P7	Target Data Analysis					P7	Target Data Analysis	0.01	1.40%	-7023.90%	-98.60%
P8	Format Data for Report Generation	6.61	661.21%	84.88%	561.21%	P8	Format Data for Report Generation				
P9	QC Report	1.81	180.62%	44.63%	80.62%	P9	QC Report				
P10	Transmit Report					P10	Transmit Report				
Metrics for Aggregated		31.09	3108.72%	-8887.01%	2408.72%	Metrics for Aggregated		0.04	3.80%	-23678.19%	-296.20%

KVA Metrics for CCOP C K					
	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking				
P2	Determine Op/Equip Mix				
P3	Load Search Func/ Coverage Plan				
P4	Search/ Collection				
P5	Target Data Acquisition/Capture	1.46	146.44%	31.71%	46.44%
P6	Target Data Processing	1.86	185.58%	46.12%	85.58%
P7	Target Data Analysis	2.05	205.23%	51.27%	105.23%
P8	Format Data for Report Generation				
P9	QC Report				
P10	Transmit Report				
Metrics for Aggregated		5.37	537.25%	129.10%	237.25%

KVA Metrics for CCOP D K					
	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking				
P2	Determine Op/Equip Mix				
P3	Load Search Func/ Coverage Plan				
P4	Search/ Collection				
P5	Target Data Acquisition/Capture	1.07	106.84%	6.40%	6.84%
P6	Target Data Processing	1.18	118.45%	15.58%	18.45%
P7	Target Data Analysis	1.24	124.28%	19.54%	24.28%
P8	Format Data for Report Generation				
P9	QC Report				
P10	Transmit Report				
Metrics for Aggregated		3.50	349.57%	41.52%	49.57%

KVA Metrics for CCOP E K					
	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking				
P2	Determine Op/Equip Mix				
P3	Load Search Func/ Coverage Plan				
P4	Search/ Collection				
P5	Target Data Acquisition/Capture	3.17	317.28%	68.48%	217.28%
P6	Target Data Processing	3.82	382.28%	73.84%	282.28%
P7	Target Data Analysis	4.15	414.91%	75.90%	314.91%
P8	Format Data for Report Generation				
P9	QC Report				
P10	Transmit Report				
Metrics for Aggregated		11.14	1114.47%	218.22%	814.47%

KVA Metrics for CCOP F K					
	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking				
P2	Determine Op/Equip Mix				
P3	Load Search Func/ Coverage Plan				
P4	Search/ Collection				
P5	Target Data Acquisition/Capture				
P6	Target Data Processing				
P7	Target Data Analysis				
P8	Format Data for Report Generation	8.16	815.92%	87.74%	715.92%
P9	QC Report	2.23	222.88%	55.13%	122.88%
P10	Transmit Report	4.09	408.99%	75.55%	308.99%
Metrics for Aggregated		14.48	1447.79%	218.43%	1147.79%

Table 24. KVA Results for USS GONZALES, Crew 3

F. ANALYZING THE KVA RESULTS FOR USS GONZALES

Looking at the results of the KVA process on the USS GONZALES 18 month deployment, we can gather some insights into to the performance of each CCOP system, each stage of the ICP and the individual operators themselves. Since the collection platform and the CCOP systems were constant over the 18 month period, we can reasonably conclude that the differences in their performance vary with a few other variables. The most likely factors for system discrepancy between crews, aside from operator proficiency or motivation, are ship's position, primary tasking, signals population and quality of reports. Crew Three had by far the most productive segment of

the GONZALES deployment, with all CCOP systems providing positive ROI numbers, except for CCOP B which was only executed once during their segment. Additionally, it should be noted that as the final crew of the GONZALES deployment, they were hampered by the same handicap as crew one, namely transit time to and from the AOR, when little to no KL production occurs. All CCOP systems had positive ROI data for the time periods when they were part of the ship primary collection priority. This leads us to believe that all CCOP systems are more than capable of providing positive ROI, if they are utilized correctly. However the CCOP systems not receiving primary tasking suffered greatly, which would lead one to the conclusion that with more operators each focusing their collection efforts on an individual CCOP system, the ROI data could be raised for all CCOP system simultaneously. This conclusion however would need further feasibility study, as the additional cost of more operators would require a greater number of KL's to increase the revenue stream, and there are obviously berthing and physical space limitations in SSES to consider.

CCOP A was the most consistent performer across all three crews, this is due mainly to its high execution rate and its high TTL per process. As stated earlier, CCOP A is so comlex because it encompasses many different functions, from administrative and overhead functions, to search, audio routing and recording and various CUB applications.

CCOP B was severely underutilized by both crew one and three, but even when it was moderately utilized by crew two, it still produced a negative ROI for that time period. The lack of performance is due to the extremely low execution frequency. It has a relatively high TTL factor and the lowest cost per sample period. It should be noted that CCOB as a standalone system has been terminated, it will be rolled into a more robust of CCOP A in future deployments. The KVA ROI data for both CCOP's A and B supports this decision.

CCOP C only displayed positive ROI numbers with crew three, and was underutilized by crew 1 and not used by crew 2. CCOP C easily display positive ROI when incorporated into the collection plan with regularity. CCOP C is also scheduled to be combined with future versions of CCOP A. This will also likely improve the ROI

numbers for CCOP C, as an integrated system it will likely be able to be at least partially automated and more convenient for the operators to use, which will dramatically increase its productivity.

CCOP D showed positive ROI data for both crews two and three, due largely in part to its large TTL per subprocess ratio and its frequency of use. A possible reason for the negative ROI for CCOP C with crew one could be a lack of other CCOP D participating units in the GONZALES AOR. It should also be noted that all execution numbers for CCOP D came from STRUM reporting and not from KL reporting.

CCOP E showed high ROI data with crew three, nearly positive with crew one and poor with crew two. The determining factor for CCOP E seems to be execution times, as it has a relatively low TTL per subprocess ratio. Crew 3 had primary tasking that utilized CCOP E for most of their segment, which accounts for their large number of execution times.

CCOP F had high ROI with every crew due mainly to execution times. Although it has a low TTL per subprocess ration, it is very inexpensive and utilized roughly twice per KL, regardless of signal type.

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III. CONCLUSIONS

Navy ISR is a cornerstone of Naval Operational Doctrine and will continue to be a critical aspect of joint operations. One of the challenges facing the DoD is to develop processes to ensure that the resources with which they are entrusted are used wisely and in support of US National Interests. It is to this end that this research intends to provide a tool to help them meet their objectives.

> This world in arms is not spending money alone. It is spending the sweat of its laborers, the genius of its scientists and the hopes of its children.
>
> —Dwight D. Eisenhower

The analysis performed here represented the transition from concept to application. The previous research was focused primarily on developing the methodology, and used a theoretical platform and crew to illustrate how ROI and KVA could be used to develop metrics of performance. The implementation of these concepts to the USS GONZALEZ deployment from Mar 05 – Aug 06 provided clear evidence that the concepts were sound and can be applied in a real-world situation.

The model used for the USS GONZALEZ was designed specifically to be scalable and configurable to apply to any platform or CCOP system configuration. Also, with slight modification, this model can be applied to Navy ISR systems other than CCOP and provide ROI on other systems of interest. This capability provides project managers with a defensible metric of measuring value of a system, and has the potential to directly affect the budgeting process.

The requirement for a Navy ISR capability is immediate and will continue to expand in the future. The Naval Transformation Roadmap of 2003 discusses how to transform ISR to an increasingly relevant capability that can support tactical naval operations and the joint operations. Effective ISR directly impacts current combat operations, as well as providing a long-term intelligence capability that supports national level priorities. As one face of Navy ISR, the CCOP program is currently filling a critical need to conduct Cryptologic missions on platforms that aren't configured with a

collection capability. The success of this quick reaction capability in many cases is resulting in permanent use by the platform.

Section 355 of the FY2004 Intelligence Authorization Act (P.L. 108-177) states the requirement for "a comprehensive and uniform analytical capability to assess the utility and advisability of various sensor and platform architectures and capabilities for the collection of intelligence ... [and] the improvement of coordination between the Department [of Defense] and the intelligence community on strategic and budgetary planning."[14] From an acquisitions standpoint, using the ROI and KVA analysis on these systems, as previously shown with the USS GONZALEZ, provides project managers with a defensible metric of value for CCOP systems. Applying this methodology to track the value-added of a technology in a core process provides leadership of any program the ability to make sound investment decisions for any system.

[14] Best, Richard. Intelligence, Surveillance, and Reconnaissance: Issues for Congress. CRS Report for Congress (RL 32508). Washington: Congressional Research Service, 22 Feb 2005. p. 2.

IV. RECOMMENDATIONS

The DoD has a clearly stated goal of "transformation" to align with current and future national security and defense objectives. At the acquisition level, this requires that investments are efficient, productive, and in support of joint operational capabilities. The following recommendations are presented to provide a way forward for continuing this effort to provide acquisition professionals with further ways this can be transformed into a more efficient process.

The most applicable software for use with KVA research models is GaussSoft, however, this software is not currently accredited for use in an SCI environment. Recommend that this software be approved through the accreditation process so that it could be integrated with existing KL and STRUM databases to produce near real-time reports. The KVA methodology is embedded in the GaussSoft modeling software, and would eliminate unnecessary intermediate steps associated with using Microsoft Excel as an intermediary. Screenshots of a Guass model for crew 1, as well as an overview of GaussSoft can be found in Appendix B. Also, as recommended in previous research, "the raw data required for the analysis residing in multiple databases of varying classification levels, data-gathering mechanisms that are less human-intensive and more automated need to be created to extract the required information."

This research has shown the application of the KVA methodology and how it can be used as a metric for project managers. However, for any application outside of this study it would be beneficial to create a community-wide KVA database that stores current TTL calculations for personnel, as well as updated numbers for the comparable costs for business intelligence.

One of the key aspect of the Housel-Kenevsky Knowledge Value Added (KVA) Methodology used in this model is the use of Time To Learn (TTL). To improve the accuracy of the output it would be advantageous to develop community wide standards for TTL by leveraging the knowledge and expertise of the CCOP engineers and the IW operators who use the systems.

Expand the human cost estimators by adding Cryptologic Technician (Maintenance) (CTM), and Cryptologic Technician (Interpretive) (CTI). This improvement would provide a greater ability to use this model against other Navy ISR systems that would involve the additional Navy ratings.

This model can also be used in a near real-time implementation with minor automation processes to allow an operational decision-maker to see a current picture of how the system is performing. By providing this capability at the strike group level, an afloat Cyptologic Resource Coordinator (CRC) could quickly recognize a drop in ROI on one of the CCOP systems under his control. This loss of ROI can provide the CRC with the ability to quickly recognize if there is a problem with a system. Also, this loss in ROI could show that if a system is functioning properly, there may be a training issue for the crew that is preventing the system for reaching its maximum efficiency. Additionally, it would be beneficial to the CRC if a method for capturing which reports are of particular value to the various Warfare Commanders, Strike Group Commander or even to National Agencies. This would allow for more refined revenue allocation, based on which CCOP systems produce more reports of real world importance than others.

The presentation of this data, in conjunction with automation measures mentioned above, could also be enhanced with recent developments. For example, Google Earth™ has recently been loaded onto JWICS. Simple programs could be written to pull data from these various databases, and present the data to a Google Earth™ server that would allow a CRC to see all of his afloat assets current location presented graphically along with the associated ROI of the afloat systems. This would allow the CRC to put numbers in context by being able to put the data in context. If an ROI number is low it could be the result of a system problem, lack of training, or simply not being in an area where collecting a specific signal type is possible. This increase in information being passed to operational decision makers requires an increased level of automation so the data is presented in a logical, customizable, and useful manner. This enables the transformation of data into information.

Implementing a KVA methodology allows program managers to be effective by creating new process performance metrics that must be collected on a routine basis.

These metrics provide leadership with the kinds of system performance information they need to make better technology investment decisions. The application of a KVA methodology for CCOP systems has shown the value of having these performance metrics. It is recommended that this methodology be applied to other systems within Navy ISR to align with transformational goals of maximizing the efficiency of the acquisition process.

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APPENDIX A. USS READINESS KVA ANALYSIS

CREW 1						PERSONNEL TIME SPENT PER PROCESS									
Operator	Time in Service (Days)	Pre-Deploy-ment Training (Days)	On-Job Training (Days)	Totals	Assigned to Processes	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Div Officer	730.00	15	292	1,037	1,2,9	40.00%	25.00%							35.00%	
Div LPO	4124.50	15	524	4,664	2-7, 9		10.00%	10.00%	20.00%	20.00%	10.00%	25.00%		5.00%	
SigOp 1	1131.50	30	486	1,648	3-7,9			20.00%	30.00%	20.00%	10.00%	10.00%		10.00%	
SigOp 2	1131.50	30	366	1,528	4-7				50.00%	25.00%	10.00%	15.00%			
SigOp 3	1131.50	30	325	1,487	4-7				50.00%	25.00%	15.00%	10.00%			
ComOp1	4124.50	20	325	4,470	8,10								90.00%		10.00%
ComOp2	1898.00	20	219	2,137	8,10								90.00%		10.00%
ComOp3	1131.50	20	184	1,336	8,10								90.00%		10.00%

CCOP A Aggregated Time to Learn =	3,443
CCOP B Time to Learn =	936
CCOP C Time to Learn =	594
CCOP D Time to Learn =	1,825
CCOP E Time to Learn =	851
CCOP F Time to Learn =	570

Assumptions:
(CCOP System Time to Learn is divided evenly over subprocesses in which they operate)

	Sub-Process Name	CCOP Assigned	Process Training t_{LH} (days)	Other Relevant t_{LH} (days)	TOTAL Tlh (days)	Tot t_{LH} - % auto (days)	CCOP t_{LIT} (days)	Avg % Automat'n	Tot t_{LIT} times % Automat'n (days)	Tot t_L for 1 Process Output (days)
P1	Review Request/Tasking	A	20	332	352	264	492	25.00%	579.82	843.70
P2	Determine Op/Equip Mix	A	10	580	590	531	492	10.00%	550.91	1,082.34
P3	Input Search Function/Coverage Plan	A	35	637	672	537	492	20.00%	626.19	1,163.54
P4	Search/Collection Process	A	35	2347	2382	1548	492	35.00%	1,325.61	2,874.02
P5	Target Data Acquisition/Capture	A	16	1613	1629	1059	492	35.00%	605.86	1,664.42
P5.1	Signal Type 1	B					312	35.00%	426.00	426.00
P5.2	Signal Type 2	C					198	35.00%	312.00	312.00
P5.3	Signal Type 3	D					608	35.00%	722.33	722.33
P5.4	Signal Type 4	E					284	35.00%	397.67	397.67
P6	Target Data Processing		340	805	1145	573		50.00%		
P6.1	Signal Type 1	B					312	50.00%	455.18	455.18
P6.2	Signal Type 2	C					198	50.00%	341.18	341.18
P6.3	Signal Type 3	D					608	50.00%	751.52	751.52
P6.4	Signal Type 4	E					284	50.00%	426.85	426.85
P7	Target Data Analysis		50	1367	1417	708		50.00%		
P7.1	Signal Type 1	B					312	50.00%	489.09	489.09
P7.2	Signal Type 2	C					198	50.00%	375.09	375.09
P7.3	Signal Type 3	D					608	50.00%	785.42	785.42
P7.4	Signal Type 4	E					284	50.00%	460.76	460.76
P8	Format Data for Report Generation	A,F	10	5718	5728	2864	682	50.00%	3,545.98	6,410.10
P9	QC Report	A,F	30	609	639	575	682	10.00%	745.73	1,320.56
P10	Transmit Report	F	14	635	649	97	190	85.00%	741.96	839.36
			560			8757			14,665.13	22,141.11

	Subprocess Name	Total t_{LIT} times % Automat'n (days)	Total t_{LH} (days)	Total t_L for 1 Process Executns (days)
P1	Review Request/Tasking	580	264	844
P2	Determine Op/Equip Mix	551	531	1,082
P3	Input Search Function/Coverage Plan	626	537	1,164
P4	Search/Collection Process	1,326	1,548	2,874
P5.1	Target Data Acquisition/Capture	606	1,059	1,664
	1	426		426
	2	312		312
	3	722		722
	4	398		398
P6	Target Data Processing		573	
	1	455		455
	2	341		341
	3	752		752
	4	427		427
P7	Target Data Analysis		708	
	1	489		489
	2	375		375
	3	785		785
	4	461		461
P8	Format Data for Report Generation	3,546	2,864	6,410
P9	QC Report	746	575	1,321
P10	Transmit Report	742	97	839
		14,665	8,757	22,141

ASSUMPTIONS				
	Sample Pd	Prior Pd	days	183.00
Avg # Reports during sample period	116		Search Mult	3.00
Length of sample period as %	100.00%	0.00%		
Avg # Reports executed/sample pd	116	-		

Asset				# executns by Asset *P1*	Total K *P1*	# executns by Asset P2	Total K *P2*	# executns by Asset P3	Total K *P3*	# executns by Asset P4	Total K *P4*
Div Officer				183	48290.04	131	69465.75	0	0.00	0	0.00
Div LPO				0	0.00	52	27786.30	61	32777.98	46	71845.95
SigOp 1				0	0.00	0	0.00	122	65555.97	70	107768.92
SigOp 2				0	0.00	0	0.00	0	0.00	116	179614.86
SigOp 3				0	0.00	0	0.00	0	0.00	116	179614.86
ComOp1				0	0.00	0	0.00	0	0.00		0.00
ComOp2				0	0.00	0	0.00	0	0.00		0.00
ComOp3				0	0.00	0	0.00	0	0.00		0.00
				P1 Human K	48290.04	P2 Human K	97252.06	P3 Human K	98333.95	P4 Human K	538844.59
CCOP A				183	106106.54	183	100815.64	183	114593.35	348	461313.37
CCOP B				0	0.00	0	0.00	0	0.00	0	0.00
CCOP C				0	0.00	0	0.00	0	0.00	0	0.00
CCOP D				0	0.00	0	0.00	0	0.00	0	0.00
CCOP E				0	0.00	0	0.00	0	0.00	0	0.00
CCOP F				0	0.00	0	0.00	0	0.00	0	0.00
				P1 IT K	106106.54	P2 IT K	100815.64	P3 IT K	114593.35	P4 IT K	461313.37
				Total P1 K	154396.58	Total P2 K	198067.70	Total P3 K	212927.30	Total P4 K	1000157.97

# executns by Asset P5	Total K *P5*	# executns by Asset P6	Total K *P6*	# executns by Asset P7	Total K *P7*	# executns by Asset P8	Total K *P8*	# executns by Asset P9	Total K *P9*	# executns by Asset P10	Total K *P10*	
0	0.00	0	0.00	0	0.00	0	0.00	81	46676.20	0	0.00	
26	27287.43	26	14763.71	48	34237.40	0	0.00	12	6668.03	0	0.00	
26	27287.43	26	14763.71	19	13694.96	0	0.00	23	13336.06	0	0.00	
32	34109.28	26	14763.71	29	20542.44	0	0.00	0	0.00	0	0.00	
32	34109.28	39	22145.56	19	13694.96	0	0.00	0	0.00	0	0.00	
0	0.00	0	0.00	0	0.00	39	110745.97	0	0.00	39	3766.29	
0	0.00	0	0.00	0	0.00	39	110745.97	0	0.00	39	3766.29	
0	0.00	0	0.00	0	0.00	39	110745.97	0	0.00	39	3766.29	Total Human K
P5 Human K	122793.42	P6 Human K	66436.68	P7 Human K	82169.76	P8 Human K	332237.92	P9 Human K	66680.28	P10 Human K	11298.86	1464337.57
13	7876.13	0	0.00	0	0.00	58	205666.67	58	43252.17	0	0.00	
13	5537.99	13	5917.37	13	6358.17	0	0.00	0	0.00	0	0.00	
52	16223.96	52	17741.49	52	19504.68	0	0.00	0	0.00	0	0.00	
0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	
103	40959.58	103	43965.46	103	47457.94	0	0.00	0	0.00	0	0.00	
0	0.00	0	0.00	0	0.00	58	205666.67	58	43252.17	116	86066.90	Total IT K
P5 IT K	70597.66	P6 IT K	67624.33	P7 IT K	73320.79	P8 IT K	411333.35	P9 IT K	86504.35	P10 IT K	86066.90	1578276.27
Total P5 K	193391.09	Total P6 K	134061.01	Total P7 K	155490.55	Total P8 K	743571.27	Total P9 K	153184.63	Total P10 K	97365.76	

Historical KVA for USS READINESS for Intelligence Collection Process
Total K Contribution and Human K

Assigned to Processes	Asset	Avg Annual Unit Costs	Budget (Cost) per Sample Pd (80%) Multiplier
1,2,9	Div Officer	$ 59,328	$ 23,731
2-7, 9	Div LPO	$ 53,098	$ 21,239
3-7,9	SigOp 1	$ 38,925	$ 15,570
4-7	SigOp 2	$ 38,925	$ 15,570
4-7	SigOp 3	$ 38,925	$ 15,570
8,10	ComOp1	$ 47,436	$ 18,974
8,10	ComOp2	$ 37,668	$ 15,067
8,10	ComOp3	$ 33,564	$ 13,426
	Total Human		$ 139,148
1-5, 8, 9	CCOP A	$ 158,333	$ 83,500
5-7	CCOP B	$ 29,167	$ 16,917
5-7	CCOP C	$ 54,545	$ 30,606
5-7	CCOP D	$ 40,000	$ 24,500
5-7	CCOP E	$ 35,000	$ 19,833
8-10	CCOP F	$ 58,000	$ 29,000
	Total IT		$ 155,523
			$ -
	Other Fixed Costs		$ -
	GRAND TOTALS		$ 294,670

Proxy Revenue & Cost Assumptions	
Market Comparable Price Per Unit (avg)	$ 3,800
Avg# Reports executed/sample pd	116
Avg Proxy for Revs - Sample Pd =	$ 440,800
Avg cost for IT Fixed Infrastructure (annual) =	$ 205,000
All other fixed costs (annual) =	$ -
Length of Sample Pd as % of Year =	50.00%
	$ -

	Subprocess Name	K for IT (automation & infras)	K for Humans	Total K	% of Total K per sub-process	Proxy Revenue Assigned to Sub-process ($US)	Cost Assigned to Sub-process ($US)	% of Total K for Human per Sub-process	Proxy Revenue Assigned to Human K ($US)	Cost Assigned to Human K ($US)
P1	Receive/Review Request/Tasking	106,106.54	48,290.04	154,396.58	5.0745%	$ 22,368	$ 21,421	1.5871%	$ 6,996	$9,492.48
P2	Determine Op/Equip Mix	100,815.64	97,252.06	198,067.70	6.5098%	$ 28,695	$ 19,985	3.1963%	$ 14,089	$8,056.72
P3	Load Search Func/Coverage Plan	114,593.35	98,333.95	212,927.30	6.9982%	$ 30,848	$ 17,166	3.2319%	$ 14,246	$5,237.92
P4	Search/Collection	461,313.37	538,844.59	1,000,157.97	32.8717%	$ 144,898	$ 36,417	17.7099%	$ 78,065	$24,488.84
P5	Target Data Acquisition/Capture	70,597.66	122,793.42	193,391.09	6.3561%	$ 28,018	$ 57,694	4.0358%	$ 17,790	$15,146.84
P6	Target Data Processing	67,624.33	66,436.68	134,061.01	4.4061%	$ 19,422	$ 38,192	2.1835%	$ 9,625	$7,573.42
P7	Target Data Analysis	73,320.79	82,169.76	155,490.55	5.1104%	$ 22,527	$41,377.99	2.7006%	$ 11,904	$10,759.30
P8	Format Data for Report Generation	411,333.35	332,237.92	743,571.27	24.4386%	$ 107,725	$ 64,316	10.9195%	$ 48,133	$42,720.48
P9	QC Report	86,504.35	66,680.28	153,184.63	5.0346%	$ 22,193	$ 32,520	2.1915%	$ 9,660	$10,924.88
P10	Transmit Report	86,066.90	11,298.86	97,365.76	3.2001%	$ 14,106	$ 14,413	0.3714%	$ 1,637	$4,746.72
		1,578,276.27	1,464,337.57	3,042,613.84	100.0000%	$ 440,800	$ 343,504	48.1276%	$ 212,147	$ 139,148

KVA Metrics for Total K

	Subprocess Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/Review Request/Tasking	1.04	104.42%	4.23%	4.42%
P2	Determine Op/Equip Mix	1.44	143.58%	30.35%	43.58%
P3	Load Search Func/Coverage Plan	1.80	179.70%	44.35%	79.70%
P4	Search/Collection	3.98	397.88%	74.87%	297.88%
P5	Target Data Acquisition/Capture	0.49	48.56%	-105.92%	-51.44%
P6	Target Data Processing	0.51	50.85%	-96.64%	-49.15%
P7	Target Data Analysis	0.54	54.44%	-83.68%	-45.56%
P8	Format Data for Report Generation	1.67	167.49%	40.30%	67.49%
P9	QC Report	0.68	68.24%	-46.54%	-31.76%
P10	Transmit Report	0.98	97.87%	-2.18%	-2.13%
Metrics for Aggregated		13.13	1313.05%	-140.86%	313.05%

Please note that the floor for ROKA is -100% (e.g., zero return on knowledge assets)

KVA Metrics for Human K

	Subprocess Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/Review Request/Tasking	0.74	73.70%	-35.68%	-26.30%
P2	Determine Op/Equip Mix	1.75	174.88%	42.82%	74.88%
P3	Load Search Func/Coverage Plan	2.72	271.98%	63.23%	171.98%
P4	Search/Collection	3.19	318.78%	68.63%	218.78%
P5	Target Data Acquisition/Capture	1.17	117.45%	14.86%	17.45%
P6	Target Data Processing	1.27	127.09%	21.32%	27.09%
P7	Target Data Analysis	1.11	110.64%	9.62%	10.64%
P8	Format Data for Report Generation	1.13	112.67%	11.25%	12.67%
P9	QC Report	0.88	88.43%	-13.09%	-11.57%
P10	Transmit Report	0.34	34.49%	-189.98%	-65.51%
Metrics for Aggregated		14.30	1430.10%	-7.03%	430.10%

Please note that the floor for ROKA is -100% (e.g., zero return on knowledge assets)

Historical KVA for USS READINESS for Intelligence Collection Process
IT Contribution

Asset	Avg Annual Unit Costs	Budget (Cost) per Sample Pd (80%) Multiplier	Proxy Revenue & Cost Assumptions		
Div Officer	$ 59,328	$ 23,731	Market Comparable Price Per Unit (avg)	$ 3,800	
Div LPO	$ 53,098	$ 21,239	Avg# Reports executed/sample pd	116	
SigOp 1	$ 38,925	$ 15,570	Avg Proxy for Revs - Sample Pd =	$ 440,800	
SigOp 2	$ 38,925	$ 15,570	Avg cost for IT Fixed Infrastructure (annual) =	$ 205,000	
SigOp 3	$ 38,925	$ 15,570	All other fixed costs (annual) =	$ -	
ComOp1	$ 47,436	$ 18,974	Length of Sample Pd as % of Year =	50.00%	
ComOp2	$ 37,668	$ 15,067			
ComOp3	$ 33,564	$ 13,426			
Total Human		$ 139,148			
CCOP A	$ 158,333	$ 83,500			
CCOP B	$ 29,167	$ 16,917			
CCOP C	$ 54,545	$ 30,606			
CCOP D	$ 40,000	$ 24,500			
CCOP E	$ 35,000	$ 19,833			
CCOP F	$ 58,000	$ 29,000			
Total IT		$ 155,523			
		$ -			
Other Fixed Costs		$ -			
GRAND TOTALS		$ 294,670			

	CCOP A K	CCOP B K	CCOP C K	CCOP D K	CCOP E K	CCOP F K	Total IT K
P1	106,106.54						106,106.54
P2	100,815.64						100,815.64
P3	114,593.35						114,593.35
P4	461,313.37	-					461,313.37
P5	7,876.13	5,537.99	16,223.96	-	40,959.58		70,597.66
P6		5,917.37	17,741.49	-	43,965.46		67,624.33
P7		6,358.17	19,504.68	-	47,457.94		73,320.79
P8	205,666.67					205,666.67	411,333.35
P9	43,252.17					43,252.17	86,504.35
P10						86,066.90	86,066.90
	1,039,623.88	17,813.53	53,470.13	-	132,382.99	334,985.74	1,578,276.27

Subprocess Name		K for IT (automation & infras)	K for Humans	Total K	% of Total K for CCOP A	Proxy Revenue Assigned to CCOP A Process K ($US)	Cost Assigned to CCOP A Process K ($US)	% of Total K for CCOP B	Proxy Revenue Assigned to CCOP B Process K ($US)	Cost Assigned to CCOP B Process K ($US)	% of Total K for CCOP C	Proxy Revenue Assigned to CCOP C Process K ($US)	Cost Assigned to CCOP C Process K ($US)
P1	Receive/ Review Request/ Tasking	106,106.54	48,290.04	154,396.58	3.49%	$ 15,372	$ 11,929						
P2	Determine Op/Equip Mix	100,815.64	97,252.06	198,067.70	3.31%	$ 14,606	$ 11,929						
P3	Load Search Func/ Coverage	114,593.35	98,333.95	212,927.30	3.77%	$ 16,602	$ 11,929						
P4	Search/ Collection	461,313.37	538,844.59	1,000,157.97	15.16%	$ 66,833	$ 11,929						
P5	Target Data Acquisition/Capture	70,597.66	122,793.42	193,391.09	0.26%	$ 1,141	$ 11,929	0.18%	$ 802	$ 5,639	0.53%	$ 2,350	$ 10,202
P6	Target Data Processing	67,624.33	66,436.68	134,061.01				0.19%	$ 857	$ 5,639	0.58%	$ 2,570	$ 10,202
P7	Target Data Analysis	73,320.79	82,169.76	155,490.55				0.21%	$ 921	$ 5,639	0.64%	$ 2,826	$ 10,202
P8	Format Data for Report Generation	411,333.35	332,237.92	743,571.27	6.76%	$ 29,796	$ 11,929						
P9	QC Report	86,504.35	66,680.28	153,184.63	1.42%	$ 6,266	$ 11,929						
P10	Transmit Report	86,066.90	11,298.86	97,365.76									
		1,578,276.27	1,464,337.57	3,042,613.84	34.17%	$ 150,616	$ 83,500	0.59%	$ 2,581	$ 16,917	1.76%	$ 7,747	$ 30,606

% of Total K for CCOP D	Proxy Revenue Assigned to CCOP D Process K ($US)	Cost Assigned to CCOP D Process K ($US)	% of Total K for CCOP E	Proxy Revenue Assigned to CCOP E Process K ($US)	Cost Assigned to CCOP E Process K ($US)	% of Total K for CCOP F	Proxy Revenue Assigned to CCOP F Process K ($US)	Cost Assigned to CCOP F Process K ($US)
0.00%	$ -	$ 8,167	1.35%	$ 5,934	$ 6,611			
0.00%	$ -	$ 8,167	1.44%	$ 6,370	$ 6,611			
0.00%	$ -	$ 8,167	1.56%	$ 6,875	$ 6,611			
						6.76%	$ 29,796	$ 9,667
						1.42%	$ 6,266	$ 9,667
						2.83%	$ 12,469	$ 9,667
0.00%	$ -	$ 24,500	4.35%	$ 13,245	$ 19,833	11.01%	$ 48,531	$ 29,000

KVA Metrics for CCOP A K					
	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking	1.29	128.87%	22.40%	28.87%
P2	Determine Op/Equip Mix	1.22	122.44%	18.33%	22.44%
P3	Load Search Func/ Coverage Plan	1.39	139.18%	28.15%	39.18%
P4	Search/ Collection	5.60	560.28%	82.15%	460.28%
P5	Target Data Acquisition/Capture	0.10	9.57%	-945.40%	-90.43%
P6	Target Data Processing				
P7	Target Data Analysis				
P8	Format Data for Report Generation	2.50	249.79%	59.97%	149.79%
P9	QC Report	0.53	52.53%	-90.36%	-47.47%
P10	Transmit Report				
Metrics for Aggregated		12.63	1262.65%	-824.76%	562.65%

KVA Metrics for CCOP B K					
	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking				
P2	Determine Op/Equip Mix				
P3	Load Search Func/ Coverage Plan				
P4	Search/ Collection				
P5	Target Data Acquisition/Capture	0.14	14.23%	-602.82%	-85.77%
P6	Target Data Processing	0.15	15.20%	-557.76%	-84.80%
P7	Target Data Analysis	0.16	16.34%	-512.16%	-83.66%
P8	Format Data for Report Generation				
P9	QC Report				
P10	Transmit Report				
Metrics for Aggregated		0.46	45.77%	-1672.75%	-254.23%

KVA Metrics for CCOP C K					
	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking				
P2	Determine Op/Equip Mix				
P3	Load Search Func/ Coverage Plan				
P4	Search/ Collection				
P5	Target Data Acquisition/Capture	0.23	23.04%	-334.04%	-76.96%
P6	Target Data Processing	0.25	25.19%	-296.92%	-74.81%
P7	Target Data Analysis	0.28	27.70%	-261.04%	-72.30%
P8	Format Data for Report Generation				
P9	QC Report				
P10	Transmit Report				
Metrics for Aggregated		0.76	75.93%	-892.00%	-224.07%

KVA Metrics for CCOP D K					
	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking				
P2	Determine Op/Equip Mix				
P3	Load Search Func/ Coverage Plan				
P4	Search/ Collection				
P5	Target Data Acquisition/Capture	-	0.00%	#DIV/0!	-100.00%
P6	Target Data Processing	-	0.00%	#DIV/0!	-100.00%
P7	Target Data Analysis	-	0.00%	#DIV/0!	-100.00%
P8	Format Data for Report Generation				
P9	QC Report				
P10	Transmit Report				
Metrics for Aggregated		-	0.00%	#DIV/0!	-300.00%

KVA Metrics for CCOP E K					
	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking				
P2	Determine Op/Equip Mix				
P3	Load Search Func/ Coverage Plan				
P4	Search/ Collection				
P5	Target Data Acquisition/Capture	0.90	89.76%	-11.41%	-10.24%
P6	Target Data Processing	0.96	96.35%	-3.79%	-3.65%
P7	Target Data Analysis	1.04	104.00%	3.85%	4.00%
P8	Format Data for Report Generation				
P9	QC Report				
P10	Transmit Report				
Metrics for Aggregated		2.90	290.10%	-11.36%	-9.90%

KVA Metrics for CCOP F K					
	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking				
P2	Determine Op/Equip Mix				
P3	Load Search Func/ Coverage Plan				
P4	Search/ Collection				
P5	Target Data Acquisition/Capture				
P6	Target Data Processing				
P7	Target Data Analysis				
P8	Format Data for Report Generation	3.08	308.23%	67.56%	208.23%
P9	QC Report	0.65	64.82%	-54.27%	-35.18%
P10	Transmit Report	1.29	128.99%	22.47%	28.99%
Metrics for Aggregated		5.02	502.05%	35.76%	202.05%

	UPC	X-DECK COST *PER X-DECK INCURRED BY N20	TRAINING *PER EVENT	AMORITIZATION FIGURE
A	$950,000	$8,000	$5,000	6
B	$175,000	$2,000	$5,000	6
C	$600,000	$5,000	$5,000	11
D	$200,000	$6,000	$7,500	5
E	$175,000	$2,000	$5,000	5
F	$58,000			1
		*System is not cross-decked		
		**Training not provided by CCOP		

	A	B	C	D	E	F			
Coverage Plan Creation/ Management	210								
Control and Processing System	120							A	3443
Database Operations	155							B	936
JMCIS Applications	260							C	594
Microsoft Applications	330					330		D	1825
KL Writer	200							E	851
Other CUB Applications	750							F	570
basic RF	66	66	66	66	66				
EM theory	198	198	198	198	198				
Basic Comms Theory	132	132	132	132	132				
Propogation Theory	66		66	66					
Antenna Theory	66		66	66					
Basic Radio DF			66	66					
SCI Network Interface	120			120					
TDOA/FDOA				360					
Geolocation processing				121					
TCP/IP Communications				120		120			
VPN				240					
ALE		180							
Near Real-time Signals Analysis		300							
RF Routing		60							
Ship navigation interface				120					
National Asset interface				150					
RF Management System	90								
Signal Acquisition System	230								
Audio Distribution & Recording	60								
Spectrum Display Operations	90								
Signal Processing Applications	300								
Demodulation/Decoding					90				
Audio/Visual Analysis					35				
Digital Signal Processing/Wireless Processing					330				
Mail Server/Exchange						90			
Data Encryption						30			

Historical Learning Time and Automation Data - 6 Month Deployment Sample Period
USS GONZALES

CREW 2						PERSONNEL TIME SPENT PER PROCESS									
Operator	Time in Service (Days)	Pre-Deploy-ment Training (Days)	On-Job Training (Days)	Totals	Assigned to Processes	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Div Officer	730.00	15	292	1,037	1,2,9	40.00%	25.00%							35.00%	
Div LPO	4124.50	15	524	4,664	2-7, 9		10.00%	10.00%	20.00%	20.00%	10.00%	25.00%		5.00%	
SigOp 1	4124.50	30	486	4,641	3-7,9			20.00%	30.00%	20.00%	10.00%	10.00%		10.00%	
SigOp 2	1898.00	30	366	2,294	4-7				50.00%	25.00%	10.00%	15.00%			
SigOp 3	1131.50	30	325	1,487	4-7				50.00%	25.00%	15.00%	10.00%			
ComOp1	4124.50	20	325	4,470	8,10								90.00%		10.00%
ComOp2	1898.00	20	219	2,137	8,10								90.00%		10.00%
ComOp3	1131.50	20	184	1,336	8,10								90.00%		10.00%
ComOp4	1131.50	20	184	1,336	8,10								90.00%		90.00%

CCOP A Aggregated Time to Learn =	3,443
CCOP B Time to Learn =	936
CCOP C Time to Learn =	594
CCOP D Time to Learn =	1,825
CCOP E Time to Learn =	851
CCOP F Time to Learn =	570

Assumptions:
(CCOP System Time to Learn is divided evenly over subprocesses in which they operate)

	Sub-Process Name	CCOP Assigned	Process Training t_{LH} (days)	Other Relevant t_{LH} (days)	TOTAL Tlh (days)	Tot t_{LH} - % auto (days)	CCOP t_{LIT} (days)	Avg % Automat'n	Tot t_{LIT} times % Automat'n (days)	Tot t_L for 1 Process Output (days)
P1	Review Request/Tasking	A	20	332	352	264	492	25.00%	579.82	843.70
P2	Determine Op/Equip Mix	A	10	580	590	531	492	10.00%	550.91	1,082.34
P3	Input Search Function/Coverage Plan	A	35	1116	1151	920	492	20.00%	721.97	1,642.42
P4	Search/Collection Process	A	35	3372	3407	2215	492	35.00%	1,684.34	3,898.94
P5	Target Data Acquisition/Capture	A	16	2245	2261	1469	492	35.00%	887.49	2,356.97
P5.1	Signal Type 1	B					312	35.00%	410.91	410.91
P5.2	Signal Type 2	C					198	35.00%	296.91	296.91
P5.3	Signal Type 3	D					608	35.00%	707.24	707.24
P5.4	Signal Type 4	E					284	35.00%	382.57	382.57
P6	Target Data Processing		340	1106	1446	723		50.00%		
P6.1	Signal Type 1	B					312	50.00%	492.78	492.78
P6.2	Signal Type 2	C					198	50.00%	378.78	378.78
P6.3	Signal Type 3	D					608	50.00%	789.11	789.11
	Signal Type 4	E					284	50.00%	464.44	464.44
P7	Target Data Analysis		50	1698	1748	874		50.00%		
P7.1	Signal Type 1	B					312	50.00%	530.52	530.52
P7.2	Signal Type 2	C					198	50.00%	416.52	416.52
P7.3	Signal Type 3	D					608	50.00%	826.85	826.85
	Signal Type 4	E					284	50.00%	502.18	502.18
P8	Format Data for Report Generation	A,F	10	6680	6690	4014	682	40.00%	3,357.78	7,371.66
P9	QC Report	A,F	30	848	878	790	682	10.00%	769.67	1,560.00
P10	Transmit Report	F	14	1597	1611	242	190	85.00%	1,559.28	1,800.92
			560			12043			16,310.05	26,755.74

Subprocess Name	Total t_{LIT} times % Automat'n (days)	Total t_{LH} (days)	Total t_L for 1 Process Executns (days)	ASSUMPTIONS	Sample Pd	Prior Pd		
Review Request/Tasking	580	264	844				Days	150.00
Determine Op/Equip Mix	551	531	1,082	Avg # Reports during sample period	102		KL Mult	3.00
Input Search Function/Coverage Plan	722	920	1,642	Length of sample period as %	100.00%	0.00%		
Search/Collection Process	1,684	2,215	3,899	Avg # Reports executed/sample pe	102	-		
Target Data Acquisition/Capture	887	1,469	2,357					
1	411		411					
2	297		297					
3	707		707					
4	383		383					
Target Data Processing		723						
1	493		493					
2	379		379					
3	789		789					
4	464		464					
Target Data Analysis		874						
1	531		531					
2	417		417					
3	827		827					
4	502		502					
Format Data for Report Generation	3,358	4,014	7,372					
QC Report	770	790	1,560					
Transmit Report	1,559	242	1,801					
	16,310	12,043	26,756					

Asset	# executns by Asset *P1*	Total K *P1*	# executns by Asset P2	Total K *P2*	# executns by Asset P3	Total K *P3*	# executns by Asset P4	Total K *P4*
Div Officer	150	39582.00	107	56939.14	0	0.00	0	0.00
Div LPO	0	0.00	43	22775.66	50	46022.40	41	90355.76
SigOp 1	0	0.00	0	0.00	100	92044.80	61	135533.64
SigOp 2	0	0.00	0	0.00	0	0.00	102	225889.40
SigOp 3	0	0.00	0	0.00	0	0.00	102	225889.40
ComOp1	0	0.00	0	0.00	0	0.00		0.00
ComOp2	0	0.00	0	0.00	0	0.00		0.00
ComOp3	0	0.00	0	0.00	0	0.00		0.00
ComOp4	0	0.00	0	0.00	0	0.00		0.00
	P1 Human K	39582.00	P2 Human K	79714.80	P3 Human K	138067.20	P4 Human K	677668.21
CCOP A	150	86972.57	150	82635.77	150	108295.37	265	446685.68
CCOP B	0	0.00	0	0.00	0	0.00	0	0.00
CCOP C	0	0.00	0	0.00	0	0.00	0	0.00
CCOP D	0	0.00	0	0.00	0	0.00	0	0.00
CCOP E	0	0.00	0	0.00	0	0.00	0	0.00
CCOP F	0	0.00	0	0.00	0	0.00	0	0.00
	P1 IT K	86972.57	P2 IT K	82635.77	P3 IT K	108295.37	P4 IT K	446685.68
	Total P1 K	126554.57	Total P2 K	162350.57	Total P3 K	246362.57	Total P4 K	1124353.89

# executns by Asset P5	Total K *P5*	# executns by Asset P6	Total K *P6*	# executns by Asset P7	Total K *P7*	# executns by Asset P8	Total K *P8*	# executns by Asset P9	Total K *P9*	# executns by Asset P10	Total K *P10*	
0	0.00	0	0.00	0	0.00	0	0.00	71	56429.28	0	0.00	
23	33308.24	23	16390.49	43	37147.98	0	0.00	10	8061.33	0	0.00	
23	33308.24	23	16390.49	17	14859.19	0	0.00	20	16122.65	0	0.00	
28	41635.30	23	16390.49	26	22288.79	0	0.00	0	0.00	0	0.00	
28	41635.30	34	24585.74	17	14859.19	0	0.00	0	0.00	0	0.00	
0	0.00	0	0.00	0	0.00	26	102353.94	0	0.00	26	6161.77	
0	0.00	0	0.00	0	0.00	26	102353.94	0	0.00	26	6161.77	
0	0.00	0	0.00	0	0.00	26	102353.94	0	0.00	26	6161.77	Total Human K
0	0.00	0	0.00	0	0.00	26	102353.94	0	0.00	26	6161.77	
P5 Human K	149887.06	P6 Human K	73757.22	P7 Human K	89155.14	P8 Human K	307061.82	P9 Human K	80613.25	P10 Human K	18485.31	1653992.01
67	59461.61	0	0.00	0	0.00	51	171246.63	51	39253.23	0	0.00	
67	27530.79	67	33016.09	67	35544.67	0	0.00	0	0.00	0	0.00	
1	296.91	1	378.78	1	416.52	0	0.00	0	0.00	0	0.00	
153	108207.83	153	120733.96	153	126508.18	0	0.00	0	0.00	0	0.00	
35	13390.09	35	16255.55	35	17576.45	0	0.00	0	0.00	0	0.00	
0	0.00	0	0.00	0	0.00	51	171246.63	51	39253.23	102	159046.76	Total IT K
P5 IT K	208887.23	P6 IT K	170384.37	P7 IT K	180045.81	P8 IT K	342493.27	P9 IT K	78506.46	P10 IT K	159046.76	1863953.30
Total P5 K	358774.29	Total P6 K	244141.59	Total P7 K	269200.95	Total P8 K	649555.09	Total P9 K	159119.71	Total P10 K	177532.07	

Historical KVA for USS READINESS for Intelligence Collection Process
Total K Contribution and Human K

Assigned to Processes	Asset	Avg Annual Unit Costs	Budget (Cost) per Sample Pd (80%) Multiplier
1,2,9	Div Officer	$ 59,328	$ 23,731
2-7, 9	Div LPO	$ 53,098	$ 21,239
3-7,9	SigOp 1	$ 38,925	$ 15,570
4-7	SigOp 2	$ 38,925	$ 15,570
4-7	SigOp 3	$ 38,925	$ 15,570
8,10	ComOp1	$ 47,436	$ 18,974
8,10	ComOp2	$ 37,668	$ 15,067
8,10	ComOp3	$ 33,564	$ 13,426
8,10	ComOp4	$ 33,564	$ 13,426
	Total Human		$ 139,148
1-5, 8, 9	CCOP A	$ 158,333	$ 83,500
5-7	CCOP B	$ 29,167	$ 16,917
5-7	CCOP C	$ 54,545	$ 30,606
5-7	CCOP D	$ 40,000	$ 24,500
5-7	CCOP E	$ 35,000	$ 19,833
8-10	CCOP F	$ 58,000	$ 29,000
	Total IT		$ 155,523
			$ -
	Other Fixed Costs		$
	GRAND TOTALS		$ 294,670

Proxy Revenue & Cost Assumptions	
Market Comparable Price Per Unit (avg)	$ 3,800
Avg# Reports executed/sample pd	102
Avg Proxy for Revs - Sample Pd =	$ 387,600
Avg cost for IT Fixed Infrastructure (annual) =	$ 205,000
All other fixed costs (annual) =	$ -
Length of Sample Pd as % of Year =	50.00%
	$ -

	Subprocess Name	K for IT (automation & infras)	K for Humans	Total K	% of Total K per sub-process	Proxy Revenue Assigned to Sub-process ($US)	Cost Assigned to Sub-process ($US)	% of Total K for Human per Sub-process	Proxy Revenue Assigned to Human K ($US)	Cost Assigned to Human K ($US)
P1	Receive/Review Request/Tasking	86,972.57	39,582.00	126,554.57	3.5974%	$ 13,944	$ 21,421	1.1251%	$ 4,361	$9,492.48
P2	Determine Op/Equip Mix	82,635.77	79,714.80	162,350.57	4.6149%	$ 17,887	$ 19,985	2.2659%	$ 8,783	$8,056.72
P3	Load Search Func/Coverage Plan	108,295.37	138,067.20	246,362.57	7.0030%	$ 27,144	$ 17,166	3.9247%	$ 15,212	$5,237.92
P4	Search/Collection	446,685.68	677,668.21	1,124,353.89	31.9605%	$ 123,879	$ 36,417	19.2632%	$ 74,664	$24,488.84
P5	Target Data Acquisition/Capture	208,887.23	149,887.06	358,774.29	10.1984%	$ 39,529	$ 57,694	4.2606%	$ 16,514	$15,146.84
P6	Target Data Processing	170,384.37	73,757.22	244,141.59	6.9399%	$ 26,899	$ 38,192	2.0966%	$ 8,126	$7,573.42
P7	Target Data Analysis	180,045.81	89,155.14	269,200.95	7.6522%	$ 29,660	$41,377.99	2.5343%	$ 9,823	$10,759.30
P8	Format Data for Report Generation	342,493.27	307,061.82	649,555.09	18.4640%	$ 71,567	$ 76,399	8.7284%	$ 33,831	$54,803.52
P9	QC Report	78,506.46	80,613.25	159,119.71	4.5231%	$ 17,531	$ 32,520	2.2915%	$ 8,882	$10,924.88
P10	Transmit Report	159,046.76	18,485.31	177,532.07	5.0465%	$ 19,560	$ 26,496	0.5255%	$ 2,037	$16,829.76
		1,863,953.30	1,653,992.01	3,517,945.31	100.0000%	$ 387,600	$ 367,670	47.0159%	$ 182,233	$ 163,314

KVA Metrics for Total K

	Subprocess Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/Review Request/Tasking	0.65	65.09%	-53.63%	-34.91%
P2	Determine Op/Equip Mix	0.90	89.50%	-11.73%	-10.50%
P3	Load Search Func/Coverage Plan	1.58	158.12%	36.76%	58.12%
P4	Search/Collection	3.40	340.16%	70.60%	240.16%
P5	Target Data Acquisition/Capture	0.69	68.51%	-45.95%	-31.49%
P6	Target Data Processing	0.70	70.43%	-41.98%	-29.57%
P7	Target Data Analysis	0.72	71.68%	-39.51%	-28.32%
P8	Format Data for Report Generation	0.94	93.68%	-6.75%	-6.32%
P9	QC Report	0.54	53.91%	-85.50%	-46.09%
P10	Transmit Report	0.74	73.82%	-35.46%	-26.18%
Metrics for Aggregated		10.85	1084.91%	-213.15%	84.91%

Please note that the floor for ROKA is -100% (e.g., zero return on knowledge assets)

KVA Metrics for Human K

	Subprocess Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/Review Request/Tasking	0.46	45.94%	-117.66%	-54.06%
P2	Determine Op/Equip Mix	1.09	109.01%	8.27%	9.01%
P3	Load Search Func/Coverage Plan	2.90	290.42%	65.57%	190.42%
P4	Search/Collection	3.05	304.89%	67.20%	204.89%
P5	Target Data Acquisition/Capture	1.09	109.03%	8.28%	9.03%
P6	Target Data Processing	1.07	107.30%	6.80%	7.30%
P7	Target Data Analysis	0.91	91.30%	-9.53%	-8.70%
P8	Format Data for Report Generation	0.62	61.73%	-61.99%	-38.27%
P9	QC Report	0.81	81.30%	-23.00%	-18.70%
P10	Transmit Report	0.12	12.10%	-726.34%	-87.90%
Metrics for Aggregated		12.13	1213.02%	-782.40%	213.02%

Please note that the floor for ROKA is -100% (e.g., zero return on knowledge assets)

Historical KVA for USS READINESS for Intelligence Collection Process

Asset	Avg Annual Unit Costs	Budget (Cost) per Sample Pd (80%) Multiplier
Div Officer	$ 59,328	$ 23,731
Div LPO	$ 53,098	$ 21,239
SigOp 1	$ 38,925	$ 15,570
SigOp 2	$ 38,925	$ 15,570
SigOp 3	$ 38,925	$ 15,570
ComOp1	$ 47,436	$ 18,974
ComOp2	$ 37,668	$ 15,067
ComOp3	$ 33,564	$ 13,426
ComOp4	$ 33,564	$ 13,426
Total Human		$ 139,148
CCOP A	$ 158,333	$ 83,500
CCOP B	$ 29,167	$ 16,917
CCOP C	$ 54,545	$ 30,606
CCOP D	$ 40,000	$ 24,500
CCOP E	$ 35,000	$ 19,833
CCOP F	$ 58,000	$ 29,000
Total IT	$ 282,045	$ 155,523
		$ -
Other Fixed Costs		$ -
GRAND TOTAL $		$ 294,670

Proxy Revenue & Cost Assumptions	
Market Comparable Price Per Unit (avg)	$ 3,800
Avg# Reports executed/sample pd	102
Avg Proxy for Revs - Sample Pd =	$ 387,600
Avg cost for IT Fixed Infrastructure (annual) =	$ 205,000
All other fixed costs (annual) =	$ -
Length of Sample Pd as % of Year =	50.00%

	CCOP A K	CCOP B K	CCOP C K	CCOP D K	CCOP E K	CCOP F K	Total IT K
P1	86,972.57						86,972.57
P2	82,635.77						82,635.77
P3	108,295.37						108,295.37
P4	446,685.68	-					446,685.68
P5	59,461.61	27,530.79	296.91	108,207.83	13,390.09		208,887.23
P6		33,016.09	378.78	120,733.96	16,255.55		170,384.37
P7		35,544.67	416.52	126,586.18	17,576.45		180,045.81
P8	171,246.83					171,246.83	342,493.27
P9	39,253.23					39,253.23	78,506.46
P10						159,046.76	159,046.76
	994,550.86	96,091.56	1,092.20	355,449.96	47,222.08	369,546.83	1,863,953.30

Subprocess Name		K for IT (automation & infras)	K for Humans	Total K	% of Total K for CCOP A	Proxy Revenue Assigned to CCOP A Process K ($US)	Cost Assigned to CCOP A Process K ($US)	% of Total K for CCOP B	Proxy Revenue Assigned to CCOP B Process K ($US)	Cost Assigned to CCOP B Process K ($US)
P1	Receive/ Review Request/ Tasking	86,972.57	39,582.00	126,554.57	2.47%	$ 9,582	$ 11,929			
P2	Determine Op/Equip Mix	82,635.77	79,714.80	162,350.57	2.35%	$ 9,105	$ 11,929			
P3	Load Search Func/ Coverage	108,295.37	138,067.20	246,362.57	3.08%	$ 11,932	$ 11,929			
P4	Search/ Collection	446,685.68	677,668.21	1,124,353.89	12.70%	$ 49,215	$ 11,929			
P5	Target Data Acquisition/Capture	208,887.23	149,887.06	358,774.29	1.69%	$ 6,551	$ 11,929	0.78%	$ 3,033	$ 5,639
P6	Target Data Processing	170,384.37	73,757.22	244,141.59				0.94%	$ 3,638	$ 5,639
P7	Target Data Analysis	180,045.81	89,155.14	269,200.95				1.01%	$ 3,916	$ 5,639
P8	Format Data for Report Generation	342,493.27	307,061.82	649,555.09	4.87%	$ 18,868	$ 11,929			
P9	QC Report	78,506.46	80,613.25	159,119.71	1.12%	$ 4,325	$ 11,929			
P10	Transmit Report	159,046.76	18,485.31	177,532.07						
		1,863,953.30	1,653,992.01	3,517,945.31	28.27%	$ 109,578	$ 83,500	2.73%	$ 10,587	$ 16,917

% of Total K for CCOP C	Proxy Revenue Assigned to CCOP C Process K ($US)	Cost Assigned to CCOP C Process K ($US)	% of Total K for CCOP D	Proxy Revenue Assigned to CCOP D Process K ($US)	Cost Assigned to CCOP D Process K ($US)	% of Total K for CCOP E	Proxy Revenue Assigned to CCOP E Process K ($US)	Cost Assigned to CCOP E Process K ($US)	% of Total K for CCOP F	Proxy Revenue Assigned to CCOP F Process K ($US)	Cost Assigned to CCOP F Process K ($US)
0.01%	$ 33	$ 10,202	3.08%	$ 11,922	$ 8,167	0.38%	$ 1,475	$ 6,611			
0.01%	$ 42	$ 10,202	3.43%	$ 13,302	$ 8,167	0.46%	$ 1,791	$ 6,611			
0.01%	$ 46	$ 10,202	3.60%	$ 13,938	$ 8,167	0.50%	$ 1,937	$ 6,611			
									4.87%	$ 18,868	$ 9,667
									1.12%	$ 4,325	$ 9,667
									4.52%	$ 17,523	$ 9,667
0.03%	$ 120	$ 30,606	10.10%	$ 27,241	$ 24,500	1.34%	$ 3,728	$ 19,833	10.50%	$ 40,716	$ 29,000

KVA Metrics for CCOP A K

	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking	0.80	80.33%	-24.48%	-19.67%
P2	Determine Op/Equip Mix	0.76	76.33%	-31.02%	-23.67%
P3	Load Search Func/ Coverage Plan	1.00	100.03%	0.03%	0.03%
P4	Search/ Collection	4.13	412.58%	75.76%	312.58%
P5	Target Data Acquisition/Capture	0.55	54.92%	-82.08%	-45.08%
P6	Target Data Processing				
P7	Target Data Analysis				
P8	Format Data for Report Generation	1.58	158.17%	36.78%	58.17%
P9	QC Report	0.36	36.26%	-175.82%	-63.74%
P10	Transmit Report				
Metrics for Aggregated		9.19	918.61%	-200.83%	218.61%

KVA Metrics for CCOP B K

	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking				
P2	Determine Op/Equip Mix				
P3	Load Search Func/ Coverage Plan				
P4	Search/ Collection				
P5	Target Data Acquisition/Capture	0.54	53.79%	-85.90%	-46.21%
P6	Target Data Processing	0.65	64.51%	-55.01%	-35.49%
P7	Target Data Analysis	0.69	69.45%	-43.99%	-30.55%
P8	Format Data for Report Generation				
P9	QC Report				
P10	Transmit Report				
Metrics for Aggregated		1.88	187.75%	-184.90%	-112.25%

KVA Metrics for CCOP C K					
	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking				
P2	Determine Op/Equip Mix				
P3	Load Search Func/ Coverage Plan				
P4	Search/ Collection				
P5	Target Data Acquisition/Capture	0.00	0.32%	-31086.78%	-99.68%
P6	Target Data Processing	0.00	0.41%	-24345.97%	-99.59%
P7	Target Data Analysis	0.00	0.45%	-22130.96%	-99.55%
P8	Format Data for Report Generation				
P9	QC Report				
P10	Transmit Report				
Metrics for Aggregated		0.01	1.18%	-77563.71%	-298.82%

KVA Metrics for CCOP D K					
	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking				
P2	Determine Op/Equip Mix				
P3	Load Search Func/ Coverage Plan				
P4	Search/ Collection				
P5	Target Data Acquisition/Capture	1.46	145.99%	31.50%	45.99%
P6	Target Data Processing	1.63	162.88%	38.61%	62.88%
P7	Target Data Analysis	1.71	170.67%	41.41%	70.67%
P8	Format Data for Report Generation				
P9	QC Report				
P10	Transmit Report				
Metrics for Aggregated		4.80	479.54%	111.52%	179.54%

KVA Metrics for CCOP E K					
	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking				
P2	Determine Op/Equip Mix				
P3	Load Search Func/ Coverage Plan				
P4	Search/ Collection				
P5	Target Data Acquisition/Capture	0.22	22.32%	-348.12%	-77.68%
P6	Target Data Processing	0.27	27.09%	-269.13%	-72.91%
P7	Target Data Analysis	0.29	29.29%	-241.39%	-70.71%
P8	Format Data for Report Generation				
P9	QC Report				
P10	Transmit Report				
Metrics for Aggregated		0.79	78.70%	-858.64%	-221.30%

KVA Metrics for CCOP F K					
	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking				
P2	Determine Op/Equip Mix				
P3	Load Search Func/ Coverage Plan				
P4	Search/ Collection				
P5	Target Data Acquisition/Capture				
P6	Target Data Processing				
P7	Target Data Analysis				
P8	Format Data for Report Generation	1.95	195.18%	48.77%	95.18%
P9	QC Report	0.45	44.74%	-123.52%	-55.26%
P10	Transmit Report	1.81	181.28%	44.84%	81.28%
Metrics for Aggregated		4.21	421.20%	-29.91%	121.20%

Historical Learning Time and Automation Data - 6 Month Deployment Sample Period
USS GONZALES

CREW 1						PERSONNEL TIME SPENT PER PROCESS									
Operator	Time in Service (Days)	Pre-Deploy-ment Training (Days)	On-Job Training (Days)	Totals	Assigned to Processes	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Div Officer	730.00	15	292	1,037	1,2,9	40.00%	25.00%							35.00%	
Div LPO	4124.50	15	524	4,664	2-7, 9		10.00%	10.00%	20.00%	20.00%	10.00%	25.00%		5.00%	
SigOp 1	1898.00	30	486	2,414	3-7,9			20.00%	30.00%	20.00%	10.00%	10.00%		10.00%	
SigOp 2	1898.00	30	366	2,294	4-7				50.00%	25.00%	10.00%	15.00%			
SigOp 3	1131.50	30	325	1,487	4-7				50.00%	25.00%	15.00%	10.00%			
ComOp1	4124.50	20	325	4,470	8,10								90.00%		10.00%
ComOp2	1131.50	20	219	1,371	8,10								90.00%		10.00%
ComOp3	1131.50	20	184	1,336	8,10								90.00%		10.00%

CCOP A Aggregated Time to Learn =	3,443
CCOP B Time to Learn =	936
CCOP C Time to Learn =	594
CCOP D Time to Learn =	1,825
CCOP E Time to Learn =	851
CCOP F Time to Learn =	570

Assumptions:
(CCOP System TTL is divided evenly over subprocesses in which it operates)

	Sub-Process Name	CCOP Assigned	Process Training t_{LH} (days)	Other Relevant t_{LH} (days)	TOTAL Tlh (days)	Tot t_{LH} - % auto (days)	CCOP t_{LIT} (days)	Avg % Automat'n	Tot t_{LIT} times % Automat'n (days)	Tot t_L for 1 Process Output (days)
P1	Review Request/Tasking	A	20	332	352	264	492	25.00%	579.82	843.70
P2	Determine Op/Equip Mix	A	10	580	590	531	492	10.00%	550.91	1,082.34
P3	Input Search Function/Coverage Plan	A	35	759	794	635	492	20.00%	650.72	1,286.18
P4	Search/Collection Process	A	35	2838	2873	1867	492	35.00%	1,497.31	3,364.58
P5	Target Data Acquisition/Capture	A	16	1889	1905	1238	492	35.00%	825.14	2,063.07
P5.1	Signal Type 1	B					312	35.00%	395.32	395.32
P5.2	Signal Type 2	C					198	35.00%	281.32	281.32
P5.3	Signal Type 3	D					608	35.00%	691.66	691.66
P5.4	Signal Type 4	E					284	35.00%	366.99	366.99
P6	Target Data Processing		340	928	1268	634		50.00%		
P6.1	Signal Type 1	B					312	50.00%	470.51	470.51
P6.2	Signal Type 2	C					198	50.00%	356.51	356.51
P6.3	Signal Type 3	D					608	50.00%	766.85	766.85
	Signal Type 4	E					284	50.00%	442.18	442.18
P7	Target Data Analysis		50	1520	1570	785		50.00%		
P7.1	Signal Type 1	B					312	50.00%	508.25	508.25
P7.2	Signal Type 2	C					198	50.00%	394.25	394.25
P7.3	Signal Type 3	D					608	50.00%	804.59	804.59
	Signal Type 4	E					284	50.00%	479.92	479.92
P8	Format Data for Report Generation	A,F	10	5166	5176	3106	682	40.00%	2,752.40	5,858.22
P9	QC Report	A,F	30	670	700	630	682	10.00%	751.86	1,381.88
P10	Transmit Report	F	14	574	588	88	190	85.00%	689.83	778.04
			560			9779			14,256.34	22,616.34

Subprocess Name	Total t_{LIT} times % Automat'n (days)	Total t_{LH} (days)	Total t_L for 1 Process Executns (days)
Review Request/Tasking	580	264	844
Determine Op/Equip Mix	551	531	1,082
Input Search Function/Coverage Plan	651	635	1,286
Search/Collection Process	1,497	1,867	3,365
Target Data Acquisition/Capture	825	1,238	2,063
1	395		395
2	281		281
3	692		692
4	367		367
Target Data Processing		634	
1	471		471
2	357		357
3	767		767
4	442		442
Target Data Analysis		785	
1	508		508
2	394		394
3	805		805
4	480		480
Format Data for Report Generation	2,752	3,106	5,858
QC Report	752	630	1,382
Transmit Report	690	88	778
	14,256	9,779	22,616

ASSUMPTIONS				
	Sample Pd	Prior Pd	Days	170.00
Avg # Reports during sample period	368		KL Mult	3.00
Length of sample period as %	100.00%	0.00%		
Avg # Reports executed/sample pe	368	-		

Asset				# executns by Asset *P1*	Total K *P1*	# executns by Asset P2	Total K *P2*	# executns by Asset P3	Total K *P3*	# executns by Asset P4	Total K *P4*
Div Officer				170	44859.60	121	64531.03	0	0.00	0	0.00
Div LPO				0	0.00	49	25812.41	57	36009.17	147	274861.85
SigOp 1				0	0.00	0	0.00	113	72018.35	221	412292.77
SigOp 2				0	0.00	0	0.00	0	0.00	368	687154.62
SigOp 3				0	0.00	0	0.00	0	0.00	368	687154.62
ComOp1				0	0.00	0	0.00	0	0.00		0.00
ComOp2				0	0.00	0	0.00	0	0.00		0.00
ComOp3				0	0.00	0	0.00	0	0.00		0.00
				P1 Human K	44859.60	P2 Human K	90343.44	P3 Human K	108027.52	P4 Human K	2061463.87
CCOP A				170	98568.91	170	93653.87	170	110622.59	957	1432625.39
CCOP B				0	0.00	0	0.00	0	0.00	0	0.00
CCOP C				0	0.00	0	0.00	0	0.00	0	0.00
CCOP D				0	0.00	0	0.00	0	0.00	0	0.00
CCOP E				0	0.00	0	0.00	0	0.00	0	0.00
CCOP F				0	0.00	0	0.00	0	0.00	0	0.00
				P1 IT K	98568.91	P2 IT K	93653.87	P3 IT K	110622.59	P4 IT K	1432625.39
				Total P1 K	143428.51	Total P2 K	183997.31	Total P3 K	218650.11	Total P4 K	3494089.26

# executns by Asset P5	Total K *P5*	# executns by Asset P6	Total K *P6*	# executns by Asset P7	Total K *P7*	# executns by Asset P8	Total K *P8*	# executns by Asset P9	Total K *P9*	# executns by Asset P10	Total K *P10*	
0	0.00	0	0.00	0	0.00	0	0.00	258	162292.64	0	0.00	
82	101234.76	82	51851.20	153	120368.20	0	0.00	37	23184.66	0	0.00	
82	101234.76	82	51851.20	61	48147.28	0	0.00	74	46369.32	0	0.00	
102	126543.44	82	51851.20	92	72220.92	0	0.00	0	0.00	0	0.00	
102	126543.44	123	77776.80	61	48147.28	0	0.00	0	0.00	0	0.00	
0	0.00	0	0.00	0	0.00	123	380980.10	0	0.00	123	10819.94	
0	0.00	0	0.00	0	0.00	123	380980.10	0	0.00	123	10819.94	
0	0.00	0	0.00	0	0.00	123	380980.10	0	0.00	123	10819.94	Total Human K
P5 Human K	455556.40	P6 Human K	233330.40	P7 Human K	288883.68	P8 Human K	1142940.29	P9 Human K	231846.62	P10 Human K	32459.81	4689711.63
1	825.14	0	0.00	0	0.00	184	506441.81	184	138342.08	0	0.00	
1	395.32	1	470.51	1	508.25	0	0.00	0	0.00	0	0.00	
341	95930.76	341	121570.76	341	134440.10	0	0.00	0	0.00	0	0.00	
81	56024.07	81	62114.51	81	65171.45	0	0.00	0	0.00	0	0.00	
367	134684.79	367	162279.75	367	176130.33	0	0.00	0	0.00	0	0.00	
0	0.00	0	0.00	0	0.00	184	506441.81	184	138342.08	368	253858.91	Total IT K
P5 IT K	287860.09	P6 IT K	346435.54	P7 IT K	376250.14	P8 IT K	1012883.62	P9 IT K	276684.16	P10 IT K	253858.91	4289443.24
Total P5 K	743416.49	Total P6 K	579765.94	Total P7 K	665133.82	Total P8 K	2155823.91	Total P9 K	508530.79	Total P10 K	286318.72	

Historical KVA for USS READINESS for Intelligence Collection Process

Total K Contribution and Human K

Assigned to Processes	Asset	Avg Annual Unit Costs	Budget (Cost) per Sample Pd (80%) Multiplier
1,2,9	Div Officer	$ 59,328	$ 23,731
2-7, 9	Div LPO	$ 53,098	$ 21,239
3-7,9	SigOp 1	$ 43,887	$ 17,555
4-7	SigOp 2	$ 43,887	$ 17,555
4-7	SigOp 3	$ 38,925	$ 15,570
8,10	ComOp1	$ 47,436	$ 18,974
8,10	ComOp2	$ 33,564	$ 13,426
8,10	ComOp3	$ 33,564	$ 13,426
	Total Human		$ 141,476
1-5, 8, 9	CCOP A	$ 158,333	$ 83,500
5-7	CCOP B	$ 29,167	$ 16,917
5-7	CCOP C	$ 54,545	$ 30,606
5-7	CCOP D	$ 40,000	$ 24,500
5-7	CCOP E	$ 35,000	$ 19,833
8-10	CCOP F	$ 58,000	$ 29,000
	Total IT		$ 155,523
			$ -
	Other Fixed Costs		$ -
	GRAND TOTALS		$ 296,998

Proxy Revenue & Cost Assumptions	
Market Comparable Price Per Unit (avg)	$ 3,800
Avg# Reports executed/sample pd	368
Avg Proxy for Revs - Sample Pd =	$ 1,398,400
Avg cost for IT Fixed Infrastructure (annual) =	$ 205,000
All other fixed costs (annual) =	$ -
Length of Sample Pd as % of Year =	50.00%
	$ -

	Subprocess Name	K for IT (automation & infras)	K for Humans	Total K	% of Total K per sub-process	Proxy Revenue Assigned to Sub-process ($US)	Cost Assigned to Sub-process ($US)	% of Total K for Human per Sub-process	Proxy Revenue Assigned to Human K ($US)	Cost Assigned to Human K ($US)
P1	Receive/Review Request/Tasking	98,568.91	44,859.60	143,428.51	1.5973%	$ 22,337	$ 21,421	0.4996%	$ 6,986	$9,492.48
P2	Determine Op/Equip Mix	93,653.87	90,343.44	183,997.31	2.0492%	$ 28,655	$ 19,985	1.0061%	$ 14,070	$8,056.72
P3	Load Search Func/Coverage Plan	110,622.59	108,027.52	218,650.11	2.4351%	$ 34,052	$ 17,563	1.2031%	$ 16,824	$5,634.88
P4	Search/Collection	1,432,625.39	2,061,463.87	3,494,089.26	38.9133%	$ 544,164	$ 38,005	22.9583%	$ 321,049	$26,076.68
P5	Target Data Acquisition/Capture	287,860.09	455,556.40	743,416.49	8.2794%	$ 115,779	$ 58,587	5.0735%	$ 70,948	$16,040.00
P6	Target Data Processing	346,435.54	233,330.40	579,765.94	6.4568%	$ 90,292	$ 38,589	2.5986%	$ 36,339	$7,970.38
P7	Target Data Analysis	376,250.14	288,883.68	665,133.82	7.4075%	$ 103,587	$41,874.19	3.2173%	$ 44,990	$11,255.50
P8	Format Data for Report Generation	1,012,883.62	1,142,940.29	2,155,823.91	24.0092%	$ 335,745	$ 62,838	12.7288%	$ 178,000	$41,243.04
P9	QC Report	276,684.16	231,846.62	508,530.79	5.6635%	$ 79,198	$ 32,719	2.5821%	$ 36,107	$11,123.36
P10	Transmit Report	253,858.91	32,459.81	286,318.72	3.1887%	$ 44,591	$ 14,249	0.3615%	$ 5,055	$4,582.56
		4,289,443.24	4,689,711.63	8,979,154.88	100.0000%	$ 1,398,400	$ 345,832	52.2289%	$ 730,369	$ 141,476

KVA Metrics for Total K

	Subprocess Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/Review Request/Tasking	1.04	104.28%	4.10%	4.28%
P2	Determine Op/Equip Mix	1.43	143.38%	30.26%	43.38%
P3	Load Search Func/Coverage Plan	1.94	193.88%	48.42%	93.88%
P4	Search/Collection	14.32	1431.81%	93.02%	1331.81%
P5	Target Data Acquisition/Capture	1.98	197.62%	49.40%	97.62%
P6	Target Data Processing	2.34	233.98%	57.26%	133.98%
P7	Target Data Analysis	2.47	247.38%	59.58%	147.38%
P8	Format Data for Report Generation	5.34	534.30%	81.28%	434.30%
P9	QC Report	2.42	242.06%	58.69%	142.06%
P10	Transmit Report	3.13	312.94%	68.04%	212.94%
Metrics for Aggregated		36.42	3641.62%	550.05%	2641.62%

Please note that the floor for ROKA is -100% (e.g., zero return on knowledge assets)

KVA Metrics for Human K

	Subprocess Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/Review Request/Tasking	0.74	73.60%	-35.87%	-26.40%
P2	Determine Op/Equip Mix	1.75	174.64%	42.74%	74.64%
P3	Load Search Func/Coverage Plan	2.99	298.57%	66.51%	198.57%
P4	Search/Collection	12.31	1231.17%	91.88%	1131.17%
P5	Target Data Acquisition/Capture	4.42	442.32%	77.39%	342.32%
P6	Target Data Processing	4.56	455.92%	78.07%	355.92%
P7	Target Data Analysis	4.00	399.72%	74.98%	299.72%
P8	Format Data for Report Generation	4.32	431.59%	76.83%	331.59%
P9	QC Report	3.25	324.61%	69.19%	224.61%
P10	Transmit Report	1.10	110.31%	9.35%	10.31%
Metrics for Aggregated		39.42	3942.45%	551.07%	2942.45%

Please note that the floor for ROKA is -100% (e.g., zero return on knowledge assets)

Asset	Avg Annual Unit Costs	Budget (Cost) per Sample Pd (80%) Multiplier
Div Officer	$ 59,328	$ 23,731
Div LPO	$ 53,098	$ 21,239
SigOp 1	$ 43,887	$ 17,555
SigOp 2	$ 43,887	$ 17,555
SigOp 3	$ 38,925	$ 15,570
ComOp1	$ 47,436	$ 18,974
ComOp2	$ 33,564	$ 13,426
ComOp3	$ 33,564	$ 13,426
Total Human		$ 141,476
CCOP A	$ 158,333	$ 83,500
CCOP B	$ 29,167	$ 16,917
CCOP C	$ 54,545	$ 30,606
CCOP D	$ 40,000	$ 24,500
CCOP E	$ 35,000	$ 19,833
CCOP F	$ 58,000	$ 29,000
Total IT	$ 282,045	$ 155,523
		$ -
Other Fixed Costs		$ -
GRAND TOTALS		$ 296,998

Proxy Revenue & Cost Assumptions	
Market Comparable Price Per Unit (avg)	$ 3,800
Avg# Reports executed/sample pd	368
Avg Proxy for Revs - Sample Pd =	$ 1,398,400
Avg cost for IT Fixed Infrastructure (annual) =	$ 205,000
All other fixed costs (annual) =	$ -
Length of Sample Pd as % of Year =	50.00%

	CCOP A K	CCOP B K	CCOP C K	CCOP D K	CCOP E K	CCOP F K	Total IT K
P1	98,568.91						98,568.91
P2	93,653.87						93,653.87
P3	110,622.59						110,622.59
P4	1,432,625.39	-					1,432,625.39
P5	825.14	295.32	95,930.76	96,024.07	134,684.79		287,860.09
P6		470.51	121,570.76	62,114.51	102,279.75		346,435.54
P7		508.25	134,440.10	65,171.45	176,130.33		376,250.14
P8	506,441.81					506,441.81	1,012,883.62
P9	138,342.08					138,342.08	276,684.16
P10						253,858.91	253,858.91
	2,381,079.81	1,374.09	351,941.62	183,310.04	473,094.88	898,642.80	4,289,443.24

	Subprocess Name	K for IT (automation & infras)	K for Humans	Total K	% of Total K for CCOP A	Proxy Revenue Assigned to CCOP A Process K ($US)	Cost Assigned to CCOP A Process K ($US)	% of Total K for CCOP B	Proxy Revenue Assigned to CCOP B Process K ($US)	Cost Assigned to CCOP B Process K ($US)
P1	Receive/ Review Request/ Tasking	98,568.91	44,859.60	143,428.51	1.10%	$ 15,351	$ 11,929			
P2	Determine Op/Equip Mix	93,653.87	90,343.44	183,997.31	1.04%	$ 14,586	$ 11,929			
P3	Load Search Func/ Coverage	110,622.59	108,027.52	218,650.11	1.23%	$ 17,228	$ 11,929			
P4	Search/ Collection	1,432,625.39	2,061,463.87	3,494,089.26	15.96%	$ 223,115	$ 11,929			
P5	Target Data Acquisition/Capture	287,860.09	455,556.40	743,416.49	0.01%	$ 129	$ 11,929	0.00%	$ 62	$ 5,639
P6	Target Data Processing	346,435.54	233,330.40	579,765.94				0.01%	$ 73	$ 5,639
P7	Target Data Analysis	376,250.14	288,883.68	665,133.82				0.01%	$ 79	$ 5,639
P8	Format Data for Report Generation	1,012,883.62	1,142,940.29	2,155,823.91	5.64%	$ 78,872	$ 11,929			
P9	QC Report	276,684.16	231,846.62	508,530.79	1.54%	$ 21,545	$ 11,929			
P10	Transmit Report	253,858.91	32,459.81	286,318.72						
		4,289,443.24	4,689,711.63	8,979,154.88	26.52%	$ 370,826	$ 83,500	0.02%	$ 214	$ 16,917

% of Total K for CCOP C	Proxy Revenue Assigned to CCOP C Process K ($US)	Cost Assigned to CCOP C Process K ($US)	% of Total K for CCOP D	Proxy Revenue Assigned to CCOP D Process K ($US)	Cost Assigned to CCOP D Process K ($US)	% of Total K for CCOP E	Proxy Revenue Assigned to CCOP E Process K ($US)	Cost Assigned to CCOP E Process K ($US)	% of Total K for CCOP F	Proxy Revenue Assigned to CCOP F Process K ($US)	Cost Assigned to CCOP F Process K ($US)
1.07%	$ 14,940	$ 10,202	0.62%	$ 8,725	$ 8,167	1.50%	$ 20,976	$ 6,611			
1.35%	$ 18,933	$ 10,202	0.69%	$ 9,674	$ 8,167	1.81%	$ 25,273	$ 6,611			
1.50%	$ 20,937	$ 10,202	0.73%	$ 10,150	$ 8,167	1.96%	$ 27,430	$ 6,611			
									5.64%	$ 78,872	$ 9,667
									1.54%	$ 21,545	$ 9,667
									2.83%	$ 39,536	$ 9,667
3.92%	$ 54,811	$ 30,606	2.04%	$ 19,823	$ 24,500	5.27%	$ 52,703	$ 19,833	10.01%	$ 139,953	$ 29,000

KVA Metrics for CCOP A K

	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking	1.29	128.69%	22.29%	28.69%
P2	Determine Op/Equip Mix	1.22	122.27%	18.22%	22.27%
P3	Load Search Func/ Coverage Plan	1.44	144.43%	30.76%	44.43%
P4	Search/ Collection	18.70	1870.42%	94.65%	1770.42%
P5	Target Data Acquisition/Capture	0.01	1.08%	-9182.45%	-98.92%
P6	Target Data Processing				
P7	Target Data Analysis				
P8	Format Data for Report Generation	6.61	661.21%	84.88%	561.21%
P9	QC Report	1.81	180.62%	44.63%	80.62%
P10	Transmit Report				
Metrics for Aggregated		31.09	3108.72%	-8887.01%	2408.72%

KVA Metrics for CCOP B K

	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking				
P2	Determine Op/Equip Mix				
P3	Load Search Func/ Coverage Plan				
P4	Search/ Collection				
P5	Target Data Acquisition/Capture	0.01	1.09%	-9058.97%	-98.91%
P6	Target Data Processing	0.01	1.30%	-7595.32%	-98.70%
P7	Target Data Analysis	0.01	1.40%	-7023.90%	-98.60%
P8	Format Data for Report Generation				
P9	QC Report				
P10	Transmit Report				
Metrics for Aggregated		0.04	3.80%	-23678.19%	-296.20%

KVA Metrics for CCOP C K

	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking				
P2	Determine Op/Equip Mix				
P3	Load Search Func/ Coverage Plan				
P4	Search/ Collection				
P5	Target Data Acquisition/Capture	1.46	146.44%	31.71%	46.44%
P6	Target Data Processing	1.86	185.58%	46.12%	85.58%
P7	Target Data Analysis	2.05	205.23%	51.27%	105.23%
P8	Format Data for Report Generation				
P9	QC Report				
P10	Transmit Report				
Metrics for Aggregated		5.37	537.25%	129.10%	237.25%

KVA Metrics for CCOP D K

	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking				
P2	Determine Op/Equip Mix				
P3	Load Search Func/ Coverage Plan				
P4	Search/ Collection				
P5	Target Data Acquisition/Capture	1.07	106.84%	6.40%	6.84%
P6	Target Data Processing	1.18	118.45%	15.58%	18.45%
P7	Target Data Analysis	1.24	124.28%	19.54%	24.28%
P8	Format Data for Report Generation				
P9	QC Report				
P10	Transmit Report				
Metrics for Aggregated		3.50	349.57%	41.52%	49.57%

KVA Metrics for CCOP E K

	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking				
P2	Determine Op/Equip Mix				
P3	Load Search Func/ Coverage Plan				
P4	Search/ Collection				
P5	Target Data Acquisition/Capture	3.17	317.28%	68.48%	217.28%
P6	Target Data Processing	3.82	382.28%	73.84%	282.28%
P7	Target Data Analysis	4.15	414.91%	75.90%	314.91%
P8	Format Data for Report Generation				
P9	QC Report				
P10	Transmit Report				
Metrics for Aggregated		11.14	1114.47%	218.22%	814.47%

KVA Metrics for CCOP F K

	Sub-Process Name	ROK as Ratio	ROK as %	ROKA	ROKI
P1	Receive/ Review Request/ Tasking				
P2	Determine Op/Equip Mix				
P3	Load Search Func/ Coverage Plan				
P4	Search/ Collection				
P5	Target Data Acquisition/Capture				
P6	Target Data Processing				
P7	Target Data Analysis				
P8	Format Data for Report Generation	8.16	815.92%	87.74%	715.92%
P9	QC Report	2.23	222.88%	55.13%	122.88%
P10	Transmit Report	4.09	408.99%	75.55%	308.99%
Metrics for Aggregated		14.48	1447.79%	218.43%	1147.79%

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APPENDIX B. GAUSSSOFT OVERVIEW

[GAUSS Overview provided courtesy of GaussSoft, Inc. <http:www.gausssoft.com>]

GAUSS is a line of software created by GaussSoft, Inc., a privately held US corporation founded in 1993, with headquarters in San Jose, California and an extended presence with offices and partners in NorthAmerica, Europe and Latin America.

GaussSoft delivers scalable Business Intelligence solutions of unrivaled performance, enabling large and medium-sized companies to control and reduce the cost of enterprise operations, increase profitability and improve organizational productivity by providing unsurpassed flexibility, scalability and ease of use.

GaussSoft's solutions are built on an integrated suite of high performance products for Profit and Cost Analysis, Multidimensional Query, and Activity Reporting that are scalable, function-rich, and easy to use.

GaussSoft has installed performance intelligence solutions in over 200 enterprise and consulting companies all around the world, including telecommunication, banking, manufacturing and agribusiness firms and government organizations. They have been implemented in customer premises by leading consulting firms including Deloitte, KPMG and Price.

GaussSoft suite includes:

Gauss - Profit and Cost Allocation Engine: This strategic decision-making and analysis solution enables companies to know which products, services, and customers are making profits and which aren't. Using different value and costing methodologies this solution helps reduce and control the cost of enterprise operations, increase profitability and improve organizational productivity.

Gauss - KVA: Knowledge Value Added (KVA) is a methodology that allows any organization to calculate the economic performance of core processes by providing an objective way to allocate revenue to the processes at any level within the organization. Knowing how much revenue corporate knowledge is producing, allows organizations to dramatically improve their effectiveness and efficiency.

Gauss - Planning: This enterprise collaborative solution allows thousands of users to perform corporate enterprise planning, including financial planning, budgeting and forecasting up to 10 times faster. When used with Gauss Profit and Gauss KVA, an organization can create plans optimized for profitability and value.

Gauss - Radial Viewer: This is a Business Intelligence (BI) front-end with graphical interaction. This tool enables all End Users to create their own queries and professional looking reports from scratch -in seconds-.

Figures 4-6 are graphical outputs of GaussSoft products.

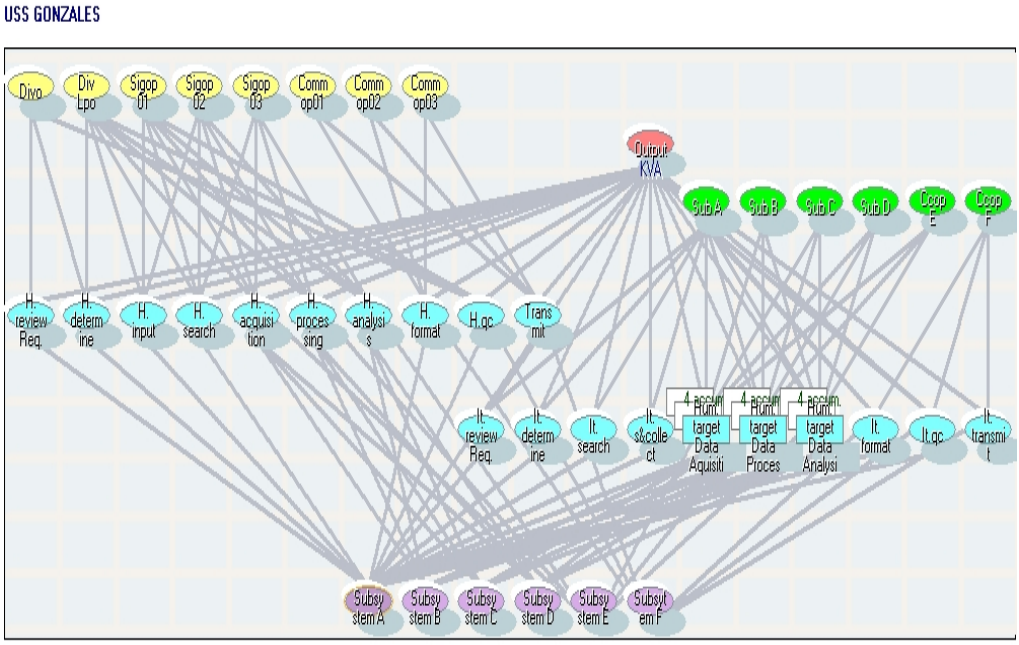


Figure 4. GaussSoft Accumulator View for KVA Case Study.

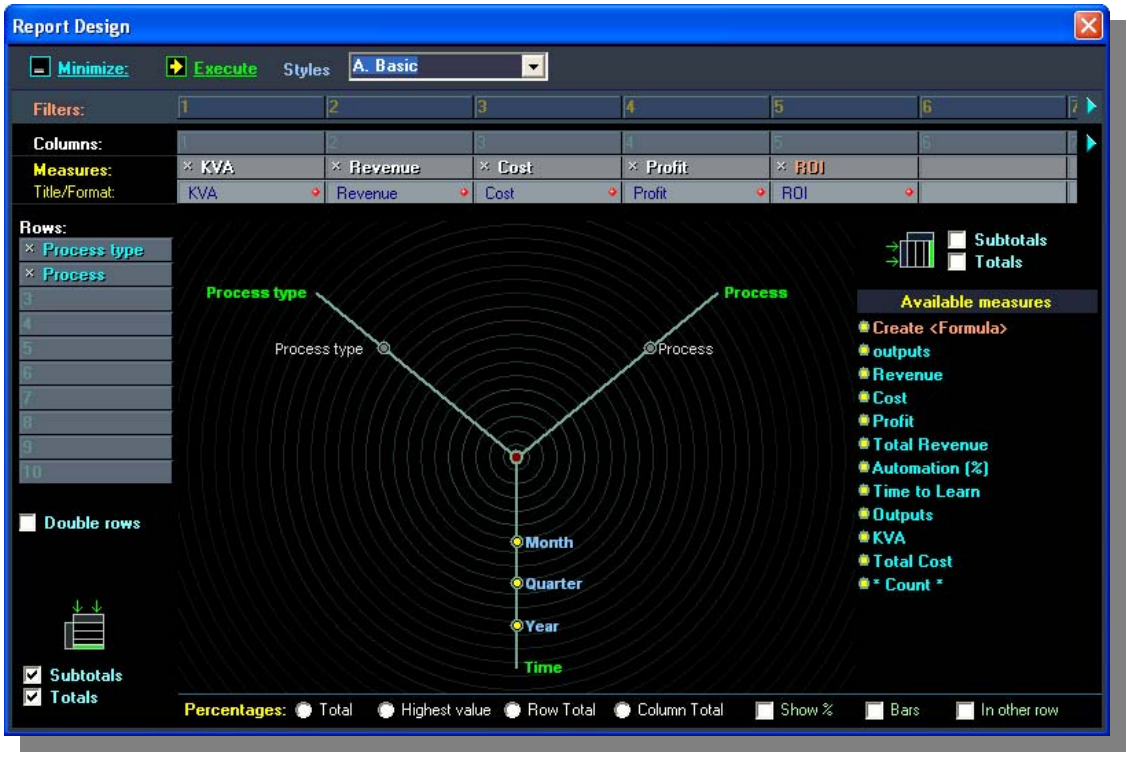
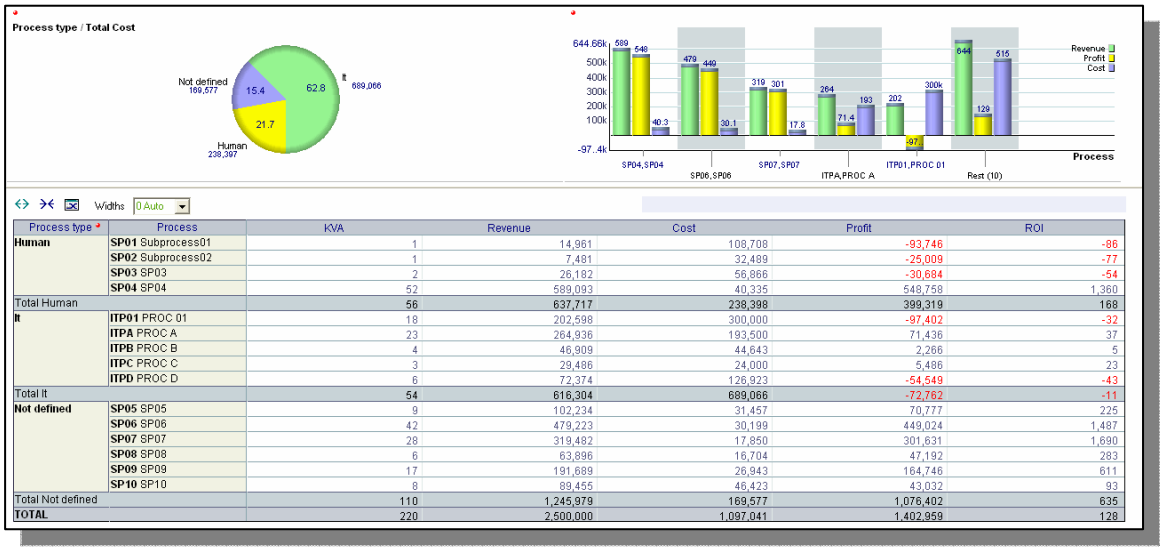


Figure 5. GaussSoft Radial Viewer Report Design Screen.



Process type / Total Cost

Process type	Process	KVA	Revenue	Cost	Profit	ROI
Human	SP01 Subprocess01	1	14,961	108,708	-93,746	-86
	SP02 Subprocess02	1	7,481	32,489	-25,009	-77
	SP03 SP03	2	26,182	56,866	-30,684	-54
	SP04 SP04	52	589,093	40,335	548,758	1,360
Total Human		56	637,717	238,398	399,319	168
It	ITP01 PROC 01	18	202,598	300,000	-97,402	-32
	ITPA PROC A	23	264,936	193,500	71,436	37
	ITPB PROC B	4	46,909	44,643	2,266	5
	ITPC PROC C	3	29,486	24,000	5,486	23
	ITPD PROC D	6	72,374	126,923	-54,549	-43
Total It		54	616,304	689,066	-72,762	-11
Not defined	SP05 SP05	9	102,234	31,457	70,777	225
	SP06 SP06	42	479,223	30,199	449,024	1,487
	SP07 SP07	28	319,482	17,850	301,631	1,690
	SP08 SP08	6	63,896	16,704	47,192	283
	SP09 SP09	17	191,689	26,943	164,746	611
	SP10 SP10	8	89,455	46,423	43,032	93
Total Not defined		110	1,245,979	169,577	1,076,402	635
TOTAL		220	2,500,000	1,097,041	1,402,959	128

Figure 6. GaussSoft Radial Viewer Sample Report.

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